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San Fernando Valley Spineflower Introduction Plan

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San Fernando Valley Spineflower Introduction Plan

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ACRONYMS AND ABBREVIATIONS

Acronym/Abbreviation	Definition
amsl	above mean sea level
CDFG	California Department of Fish and Game
CDFW	California Department of Fish and Wildlife
psi	pounds per square inch
SCP	Spineflower Conservation Plan
USFWS	U.S. Fish and Wildlife Service

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1 INTRODUCTION

This San Fernando Valley Spineflower Introduction Plan ("Introduction Plan") outlines an introduction program for San Fernando Valley spineflower ("spineflower"; *Chorizanthe parryi* var. *fernandina*).[1] Spineflower is the subject of the Newhall Ranch Spineflower Conservation Plan ("SCP") (Dudek 2010), which was developed to minimize and fully mitigate impacts to spineflower from authorized development on property of The Newhall Land and Farming Company ("Newhall Land") in the Santa Clara River Valley in northwestern Los Angeles County. The SCP outlines a conservation strategy to maximize the long-term persistence of spineflower through the designation and management of seven spineflower preserves in northwestern Los Angeles County (Figure 1, Regional Map; Figure 2, Project Vicinity; and Figure 3, Spineflower Conservation Plan and San Fernando Valley Spineflower Preserves).

This Introduction Plan builds on the conservation strategy outlined in the SCP by identifying additional tracts of land containing habitat conditions that are considered suitable for introduction of the species based on criteria assessed in the 2017 San Fernando Valley Spineflower Habitat Characterization Study by McGraw ("Habitat Characterization Study") (Appendix A), including two locations outside the current range of the species that are within the historic range of spineflower (Figure 4, Proposed Additional Conservation Areas for Enhancement and Introduction). Additionally, this Introduction Plan proposes habitat enhancement and spineflower introduction at sites within the Additional Conservation Areas (see Table 1). The goal is to establish a minimum of two new self-sustaining and persistent spineflower populations with protections from future development (i.e., conservation easements or covenants restricting future development) at currently unoccupied sites in at least two ecoregions, one of which may be in the same ecoregion as existing spineflower occurrences (Figure 5, Historic and Existing Spineflower Populations with Proposed Additional Conservation Areas, and Figures 6-1 through 6-6, Proposed Spineflower Introduction Sites). These measures will increase the resiliency of the existing spineflower population at Santa Clarita and enhance the redundancy of representation of the species.

[1] In this document, where not specified otherwise, "spineflower" refers to the San Fernando Valley spineflower (*Chorizanthe parryi* var. *fernandina*).

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Table 1
Additional Conservation Areas/Proposed Spineflower Introduction Locations

Additional Conservation Area	Land Owner	Land Area (acres)	Potential Introduction Sites (acres)[a]	Elevation Range (feet)	Ecoregion
San Martinez Grande Preserve Expansion – Los Angeles County	Newhall Land	410	5	880–1,795	Venturan–Angeleno Coastal Hills
Potrero Preserve Expansion	Newhall Land	80	2	903–1,160	Venturan–Angeleno Coastal Hills
San Martinez Grande Preserve Expansion – Ventura County	Newhall Land	335	2	880–1,840	Venturan–Angeleno Coastal Hills
Castaic Mesa	Newhall Land	316	11	1,120–1,730	Southern California Lower Montane Shrub and Woodland
Ventura County – Facing Simi Valley	Newhall Land	357	17	1,890–3,020	Venturan–Angeleno Coastal Hills
Elizabeth Lake	Land Veritas	7[b]	2	3,320–3,360	Arid Montane Slopes
	Total	1,498 acres	39 acres	N/A	N/A

N/A = not applicable.
[a] Within the potential introduction sites that have been identified, spineflower introduction will occur in a minimum of 10 acres, combined, across the Additional Conservation Areas.
[b] Newhall Land has acquired the right to conduct Introduction Plan activities within approximately 7 acres of the Elizabeth Lake property, containing approximately 2 acres of potential spineflower introduction sites. Because the 7 acres are located within a larger area that is designated for conservation as part of the Petersen Ranch Mitigation Bank, the 7 acres are not counted toward the total acreage of Additional Conservation Areas.

1.1 Purpose of the Introduction Plan

This Introduction Plan is a conservation program to enhance habitat and introduce spineflower at currently unoccupied sites within the Additional Conservation Areas to promote the conservation of the species. Additionally, this Introduction Plan allows opportunities for additional scientific research related to introduction of spineflower and species persistence in introduced areas, spineflower habitat management, and the species' response or adaptation to new habitat conditions. The conservation program will introduce spineflower into currently unoccupied areas that provide suitable habitat[2] for this species. The primary goal of the Introduction Plan is to establish a minimum of two new self-sustaining and persistent spineflower populations at currently unoccupied sites in at least two ecoregions, one of which may be the same as existing spineflower occurrences. Based on the U.S. Geological Survey's Ecoregions of California (USGS 2017), ecoregions denote areas of general similarity in ecosystems and in the type,

2 *Suitable habitat* is used in this document to describe habitat that meets certain criteria assessed in the Spineflower Habitat Characterization Study conducted by Dr. Jodi McGraw (Appendix A). Suitable habitat shares specific biotic and abiotic habitat criteria with spineflower-occupied areas within the Santa Clarita population (Appendix C).

quality, and quantity of environmental resources, and are designed to serve as a spatial framework for ecosystem monitoring and management. Currently, spineflower is known only from one ecoregion (Venturan–Angeleno Coastal Hills), but it may have historically occurred in as many as four ecoregions (Figure 5).

The Introduction Plan will introduce spineflower on a minimum of 10 acres within the Additional Conservation Areas, which include areas that are regionally proximal to existing spineflower occurrences and contain suitable conditions for the species (e.g., San Martinez Grande Preserve Expansion – Los Angeles County and Ventura County, and Potrero Preserve Expansion); areas that are proximal to extirpated historical occurrences (e.g., Castaic Mesa and Elizabeth Lake) and sites that provide unique opportunities for expansion of the species (e.g., Ventura–Simi). See Table 1. Within these areas, sites have been identified as suitable for spineflower introduction based on their similarity to currently occupied or extirpated locations, using parameters such as elevation, aspect and slope, composition of soils, and vegetation communities. This Introduction Plan provides the framework, guidelines, and procedures designed to maximize the potential benefit of these areas for spineflower conservation.

The general approach outlined in this Introduction Plan includes the following:

- Identify suitable unoccupied habitat areas for spineflower introduction.
- Use seed introduction trials to inform and optimize the effectiveness of spineflower introduction carried out under this Introduction Plan.
- Enhance targeted introduction sites through weed control and land use manipulation/control.
- Introduce spineflower into the targeted sites.
- Manage the introduction sites following spineflower introduction to maximize opportunities for spineflower to establish.
- Establish a long-term management program for the introduction sites that includes maintaining a high habitat value for spineflower.
- Provide for scientific research to study spineflower introduction and persistence at the introduction sites.
- Provide for opportunities to evaluate spineflower adaptation related to habitat requirements and future habitat conditions (including climate change).

1.2 Background

The San Fernando Valley spineflower was thought to be extinct prior to its discovery in 1999 on the former Ahmanson Ranch property in the southeast edge of the Simi Hills, located in Ventura

County in the vicinity of Ahmanson Ranch. Prior to its rediscovery, spineflower had last been collected in 1929 from the Castaic area of Los Angeles County (69 FR 24876–24882).

The U.S. Fish and Wildlife Service (USFWS) designated the spineflower as a candidate species for listing under the federal Endangered Species Act of 1973 (16 U.S.C. Section 1531, et seq.) in the October 25, 1999, Candidate Notice of Review (64 FR 57534–57541). The species was subsequently discovered on land owned by Newhall Land in the Santa Clarita area of northwest Los Angeles County in 2000. The California Department of Fish and Wildlife (CDFW) listed the spineflower as an endangered species under the California Endangered Species Act (California Fish and Game Code, Sections 2050–2097), effective September 8, 2002.

In 2003, the Ahmanson Ranch property was acquired by the State of California through the Wildlife Conservation Board and transferred to the Santa Monica Mountains Conservancy for the purposes of wildlife habitat preservation, corridor protection, restoration and management, wildlife-oriented education and research, and compatible public uses that are consistent with wildlife habitat preservation and protection of sensitive biological resources. It is now called the Upper Las Virgenes Canyon Open Space.[3] In its 2003 Candidate Notice of Review, the USFWS lowered spineflower's listing priority to 6 (to reflect threats that are high but non-imminent) (69 FR 24876–24882). Currently, spineflower is known from the former Ahmanson Ranch property and land owned by Newhall Land in the Santa Clarita area. These two spineflower populations are approximately 17 miles apart.

In 2016, the USFWS issued a proposed rulemaking to list the spineflower as threatened under the federal Endangered Species Act (81 FR 63454–63466). Newhall Land has developed a draft candidate conservation agreement to reflect the conservation measures already carried out under the SCP; to incorporate the most recent results of research on spineflower occurrence, ecology, and habitat characterization; and to incorporate the Additional Conservation Measures described in this Introduction Plan.

1.3 Relationship of the Introduction Plan to the SCP

The SCP outlines a conservation strategy for spineflower through the designation and management of seven spineflower preserves, totaling 227 acres, that will protect 15.40 acres of occupied spineflower habitat (Dudek 2010). The system of preserves protects the core occurrences of spineflower at the Santa Clarita location. The spineflower occurrences within the preserve system will be managed and monitored within an adaptive management framework to maintain or enhance the protected spineflower occurrences. Additionally, the SCP provides for

[3] Because much of the literature concerning spineflower on the former Ahmanson Ranch pre-dates the name change to the Upper Las Virgenes Canyon Open Space, "Ahmanson Ranch" is used in the rest of this document.

spineflower habitat enhancement and includes additional unoccupied areas within the spineflower preserves to promote expansion of existing spineflower occurrences (Dudek 2010).

The preserve design and adaptive management framework proposed in the SCP were developed based on a series of biological goals and objectives that describe the desired conditions of (1) the spineflower populations, (2) the communities in which the spineflower occurs, and (3) the ecosystem processes known or hypothesized to maintain the spineflower populations and associated communities (Dudek 2010).

This Introduction Plan provides a unique opportunity to expand upon the SCP preserve system and conservation efforts for spineflower. This Introduction Plan builds on the conservation strategy outlined in the SCP by identifying additional large tracts of land containing habitat conditions that are considered suitable for introduction of the species based on criteria assessed in the Habitat Characterization Study (Appendix A), both adjacent to extant occurrence locations in the San Martinez Grande and Potrero SCP spineflower preserves and in additional sites within the species' historical range.

1.4 Species Distribution and Phenology

Spineflower is a member of the Polygonaceae family and is among approximately 50 taxa in the genus *Chorizanthe* that occur in temperate western North America and southwestern South America (Jepson Flora Project 2016).

1.4.1 Historical Distribution

Historical records include specimens collected between 1879 and 1929 that represent at least 10 spineflower locations in Los Angeles and Orange counties (CDFG 2001; CDFW 2017)[4] (Figure 5). In Los Angeles County, collections were made at nine locations within the San Fernando Valley along the foothills of the San Gabriel Mountains. Only one collection was made in Orange County, from hills near Santa Ana. Spineflower was thought to occur in San Diego and San Bernardino counties, but these locations were later determined to be mislabeled or misidentified (CDFG 2001).

Table 2 summarizes the 10 historical occurrences of spineflower previously located in Los Angeles County and Orange County (CDFG 2001; CDFW 2017). All of the historical occurrences listed in Table 2, except Element Occurrence 6, are considered extirpated (CDFW 2017). Element Occurrence 6 is in the San Martinez Grande Preserve Area; historical observations made in the area in 1893 are attributed to this occurrence.

[4] In January 2013, the California Department of Fish and Game (CDFG) changed its name to the California Department of Fish and Wildlife (CDFW). In this document, references to guidance or documents prior to the name change use CDFG, and references after this date use CDFW.

Table 2
Summary of the Historical Locations of Spineflower

Element Occurrence	County	Location	Last Year Observed
1	Los Angeles	Little Tujunga Wash, along the southwest base of the San Gabriel Mountains	1920
2	Los Angeles	Elizabeth Lake, on sandy banks	1929
5	Los Angeles	Near Castaic, sandy wash along Castaic Valley	1929
6	Los Angeles	Newhall, general vicinity	1893
7	Los Angeles	Chatsworth Park, general vicinity	1901
8	Orange	Hills near Santa Ana, believed to have been in the foothills of Lomas de Santiago (CDFG 2001)	1902
9	Los Angeles	Ballona Harbor, in the general vicinity of Ballona Creek	1901
10	Los Angeles	San Fernando, in the vicinity of lower San Fernando dam just downstream from Los Angeles reservoir and upper Van Norman Lake	1922
12	Los Angeles	Burbank, general vicinity	1890
13	Los Angeles	Toluca, vicinity of North Hollywood[a]	Before 1930

[a] There is an additional historical collection of spineflower housed at the Rancho Santa Ana Botanic Gardens dated 1930 (CDFG 2001).

1.4.2 Current Distribution and Abundance

Currently, spineflower is known from two general locations (also called "populations" in this Introduction Plan): the former Ahmanson Ranch property in the vicinity of Laskey Mesa in Ventura County (Element Occurrence 11; CDFW 2017) and land owned by Newhall Land in the Santa Clarita area in northwestern Los Angeles County (Element Occurrences 6 and 14–24; CDFW 2017). The Ahmanson Ranch and Santa Clarita populations are approximately 17 miles apart. The Ahmanson Ranch population is within 1 mile of the historical collection sites at Chatsworth Park (Element Occurrence 7 in 1901). Both of the two currently known populations contain multiple occurrences of spineflower.

The Ahmanson Ranch population is located on the southern edge of the Simi Hills near the City of Calabasas. The Simi Hills are within the Transverse Ranges geographic subdivision of California (Hickman 1993). Following the rediscovery of spineflower at Ahmanson Ranch, biologists working with Sapphos Environmental Consulting conducted a directed search for spineflower that included historical localities, suitable habitat areas within the historical range of spineflower, and suitable habitat areas near the existing population at Ahmanson Ranch. A total of 7 historical locations and 21 other locations were surveyed, with negative results, in 1999 and 2000 (Sapphos 2001).

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Existing data on the abundance of spineflower and the area occupied are from annual surveys conducted at Ahmanson Ranch and Santa Clarita (Table 3). Surveys of the Ahmanson Ranch population were conducted in 1999, 2000, 2001, and 2002.

Table 3
Annual Spineflower Area Occupied at Ahmanson Ranch and Santa Clarita

Year	Ahmanson Ranch (Acres Occupied)	Santa Clarita location (Acres Occupied)
1999	6.7	—
2000	10.5	—
2001	12.9	—
2002[a]	3.6	—
2003	—	16.4
2004	—	5.3
2005	—	11.5
2006	—	8.5
2007	—	0.1
2011	—	4.5
2012	—	1.4
2013	—	1.6
2014	—	5.5
2015	—	5.7
2016	—	1.8
2017	—	2.6

The number of individual spineflower plants fluctuates dramatically, mostly in response to precipitation. For example, in 2005, total spineflower plants in four occurrences within the Santa Clarita population were estimated at approximately 6.4 million (Dudek & Associates 2005a). In 2007, however, the total number of spineflower in these four areas was estimated at approximately 760 plants (Dudek 2007a). The estimated number of spineflower plants then jumped to an estimated 1.0 million in 2014 (Dudek 2014). Other occurrences in the Santa Clarita population show similar variability (Dudek & Associates 2005b; Dudek 2007b, 2017).

The variation of spineflower abundance and area occupied from year to year is typical of annual plant species in a highly variable environment. In the case of spineflower, there is a strong correlation between rainfall and spineflower abundance (McGraw 2012). At Ahmanson Ranch, only 50% of the spineflower were observed to flower in 2002, a below-average rainfall year

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(Sapphos 2003a). In relatively natural habitat areas of Grapevine Mesa in the Santa Clarita location in the spring of 2002, only a handful of individuals survived to reproduce; these were typically at locations protected from wind, beneath the drip line of a shrub, or otherwise more protected from exposure. Failed, desiccated rosettes were commonly observed (Meyer 2004). With better weather conditions in 2003 and 2005, the spineflower population at the Santa Clarita location expressed itself with a number of plants several orders of magnitude greater than in 2002.

The Santa Clarita population numbers described above are estimates: spineflower occurrences are highly aggregated and densities vary considerably within the same survey polygon. Preliminary studies indicate that variability between occurrences within a given year is lower than the variability from year to year, although the exact area of occupancy has changed each year (Dudek & Associates 2006a). For example, in 2002, 2004, and 2007—years of low abundance—spineflower occurred in some areas where it did not occur in 2003, a highly abundant year. An analysis of variance of the density of spineflower individuals and acres occupied at five of the main occurrences in the Santa Clarita location produced contrasting results. The area occupied varied more between sites than between years, while density varied more between years than between sites. There was no significant interaction between year and site when a two-way analysis of variance was used, which means all of the sites tended to change year to year in a similar fashion. More data are needed, but the preliminary interpretation of the analyses of variance is that spineflower distribution appears to be controlled by intrinsic environmental characteristics (e.g., soil type), while population density (and, in turn, actual numbers of individuals) appears to be controlled by extrinsic environmental characteristics (e.g., rainfall).

There is also substantial variability in the overall size of individual plants, which has a direct bearing on reproductive output. There is a positive logarithmic relationship between the size of spineflower individuals and involucre production, with smaller plants producing fewer involucres than larger plants (Sapphos 2003b). That is not to say that small individuals are less valuable to population growth and persistence. Small-size plants may be the result of poor conditions at a given micro-site where the plant was growing, but also may relate to timing of germination. Later-germinating plants may not achieve the same overall size as plants that have had more time to develop (Sapphos 2003b). In rainfall years with multiple germination events, a mix of plant sizes may represent different ages of individual plants. Later-germinating individuals likely contribute to the adaptability of the species to different environmental conditions. Likewise, small individuals that still successfully produce seed may reflect genetic diversity that may be important for long-term viability in a highly variable environment.

1.4.3 Species Phenology

Spineflower is a low-growing herbaceous annual. Germination occurs following the onset of late-fall and winter rains and typically represents different cohorts germinating over the winter and early spring growing season. Spineflower initially forms a basal rosette. As day lengths increase in springtime, flowering stalks are produced. Flowering generally occurs between April and June. Overall size of spineflower can vary, ranging from small, button-sized erect plants with little branching to larger, decumbent plants up to 1.5 decimeters (5.9 inches) in height and between 0.5 and 6 decimeters (between 2 and 24 inches) across. Leaves are oblong to oblanceolate, 0.2 to 1.3 centimeters (0.1 to 0.5 inches) wide, and form a basal rosette. The involucre is urn-shaped, with six bracts and straight awns enclosing its small white flower, which measures 2.5 to 3 millimeters (approximately 0.1 inches) (Jepson Flora Project 2016). Each involucre produces a single flower that forms, at most, a single seed.

San Fernando Valley spineflower can generally be differentiated from co-occurring spineflowers, including Turkish rugging (*Chorizanthe staticoides*) and leather spineflower (*Lastarriaea coriacea*), by its decumbent habit, white flowers, entire leaves, and straight-tipped involucral awns. Plants become desiccated and senesce by late summer, leaving branches brittle and dry but usually with intact involucres still attached and containing seed. San Fernando Valley spineflower disarticulates (breaks apart) with clumps of four to eight involucres that are rigidly held together. In contrast, the involucres of Turkish rugging and leather spineflower disarticulate readily and one by one. Seeds are eventually released from the involucre, but the exact mechanism and timing of this release has not been described.

1.5 Soil and Habitat Characterization

1.5.1 Soils and Geology

A geologic investigation of historical and existing locations indicated that spineflower sites are associated with two generic conditions: (1) alluvial deposits of riverine systems and (2) contact points between exposed bedding planes where the parent material is exposed at the surface (Sapphos 2000). These conditions are consistent with the observation that spineflower typically occurs in areas with thin, poorly developed soils that are relatively low in nutrients. At the Santa Clarita location, spineflower occurs on eight geologic formations: Artificial fill, Quaternary alluvium, Quaternary landslide, Quaternary older alluvium, Quaternary slopewash, Quaternary terrace deposits, undifferentiated terrace deposits, and undifferentiated Saugus Formation. The Saugus Formation consists of interbedded sandstones, siltstones, and mudstones deposited during late-Pliocene and early Pleistocene times, 2.5 to 0.7 million years before present. The Quaternary formations were deposited in the past 1.8 million years, during Pleistocene times (Allan E. Seward 2004). At Ahmanson Ranch, the underlying geology is Tertiary-age unnamed shale and sandstone, about 5.1 million years before present (Dibblee 1992), which is older than the underlying geologic formations at the Santa Clarita location.

Existing and historical spineflower sites are potentially associated with a variety of soil units. Soil units at historical sites were highly variable, and 7 of the 12 historical sites are so lacking in specificity regarding location that it is not possible to determine the historical geologic and soil composition at these locations. Five sites that could be correlated with geologic data did not match those occurring on Ahmanson Ranch (Sapphos 2001). At Ahmanson Ranch, spineflower is associated with San Andreas sandy loam (2% to 9% slopes), Zamora loam (2% to 9% slopes), and Santa Lucia shaly, silty clay loam (15% to 30% slopes) (GLA and Sapphos 2000). At the Santa Clarita location, although spineflower sites occur on a variety of soil units, approximately 90% of polygons occurred within Terrace escarpments, Castaic-Balcom silty clay loams (30% to 50% slopes), Castaic-Balcom silty clay loams (30% to 50% slopes, eroded), Zamora loam (2% to 9% slopes), and Saugus loam (30% to 50% slopes). The occupied soils at Ahmanson Ranch and at the Santa Clarita location appear similar in that they are primarily loam or silty clay loam, with a much lower level of occurrence on sandy loams.

At both Ahmanson Ranch and the Santa Clarita location, spineflower occurs primarily in areas of poorly developed soils with shallow depth to bedrock. At Ahmanson Ranch, soils in adjacent unoccupied areas with dense grasses were found to be more developed and have higher levels of nutrients. Spineflower plants also frequently grew in areas of rock outcroppings in weathered, degraded parent material featuring poorly developed soils lacking true soil horizons (Sapphos 2001). Spineflower distribution at Ahmanson Ranch is possibly influenced by past land use and invasion of European annual grasses and forbs and may be a response to a buildup of thatch, in light of the fact that livestock were removed from annual grasslands on Ahmanson Ranch about 8 years prior to the discovery of spineflower at Ahmanson Ranch (Meyer 2004). Similarly, plants occurring in undisturbed areas at the Santa Clarita location consistently occur on soils lacking the organic soil horizon, whereas occupied mesa-tops typically consist of very well-developed soils (Allan E. Seward 2002).

Based on a study characterizing the habitat of slender-horned spineflower (*Dodecahema leptoceras*), a species closely related to San Fernando Valley spineflower, it was noted that soil in plots occupied by slender-horned spineflower had lower levels of nitrogen, phosphorous, electrical conductivity, and organic materials than distant unoccupied plots that appeared visually suitable. In addition, the soil in the occupied plots had higher values of nitrogen and electrical conductivity than unoccupied adjacent suitable plots. The soil in occupied plots had lower values of phosphorus and organic material than unoccupied adjacent suitable plots (Allen 1996). Therefore, it is important to note that while unoccupied adjacent and distant plots were visually similar to occupied plots, there were differences in soil characteristics that may influence the success of slender-horned spineflower populations.

Similar soils analyses have been conducted for San Fernando Valley spineflower-occupied sites versus unoccupied (Dudek 2010; Appendix A). Preliminary results of the Habitat Characterization Study (Appendix A) indicate that spineflower preferentially occurs in lower-fertility soils, higher sand and lower silt content, lower water-holding capacity, lower organic matter, lower cation-exchange capacity, lower base saturation, lower pH, lower concentrations of nitrogen as ammonia and potassium, lower concentrations of calcium and sulfur, lower concentrations of boron and chlorine, and higher concentrations of aluminum (Appendix A).

The bulk density of the soil at occupied spineflower sites also differs from adjacent unoccupied areas. Soils at Ahmanson Ranch spineflower sites generally have higher bulk densities (dry weight of soil per unit of volume; used to estimate compaction in similar soil types) than adjacent areas supporting non-native weedy species (St. John 1999, as cited in Sapphos 2001).

1.5.2 Disturbance

Spineflower often occurs in areas with disturbed soils. For instance, it occurs along infrequently used dirt roads and trails at Ahmanson Ranch (Sapphos 2001). Within portions of the Santa Clarita location, spineflower occurs along the edges of dirt roads that have been in use for decades for utility line maintenance, and in a number of areas of undisturbed sage scrub associated with fossorial (burrowing) rodent activity—in particular, San Martinez Grande Canyon and the areas within and surrounding Potrero Canyon, Grapevine Mesa, and Airport Mesa, and in annual grasslands that have been used for grazing for decades.

1.5.3 Elevation, Slope, and Aspect

Existing spineflower occurrences in the vicinity of Ahmanson Ranch are between 1,200 and 1,400 feet above mean sea level (amsl), whereas occurrences at the Santa Clarita location are between 930 and 1,469 feet amsl (CDFW 2017). The historical elevation range of spineflower is between 0 feet amsl (Ballona wetlands) and 4,139 feet amsl (Elizabeth Lake) (CDFW 2017). Spineflower occurs primarily on slopes with a south-facing aspect. These southern exposures experience more sunlight and heat, which leads to less dense herbaceous growth and/or less dense vegetation when compared to areas with a northern exposure. Therefore, spineflower's tendency to occur on these slope exposures may be due to the prevalence of more sparsely vegetated habitat areas on hotter, drier slopes.

At Ahmanson Ranch, site characteristics from 1999 to 2002 surveys indicated that 96% of occupied habitat had a predominantly south-facing aspect (Sapphos 2002). Spineflower sites at the Santa Clarita location are mostly on slopes with a south-facing component, with 72% of sites occurring on south-, southwest-, or southeast-facing slopes.

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At Ahmanson Ranch, spineflower occurs on slopes with gradients between 4% and 47%, with an average slope of 20% (Sapphos 2001). These calculations may overestimate the slope because spineflower tends to occur in localized depressions or along narrow shelves and benches at Ahmanson Ranch (CDFG 2001). At the Santa Clarita location, approximately 90% of spineflower occurrences are on slopes with gradients between 0% and 25%.

1.5.4 Habitat and Species Composition

Historical accounts describe spineflower as occurring within scrub communities in washes, riverbeds, and upland sites. Although historical accounts do not provide specific information regarding local habitat conditions, based on their locations, occurrences described within upland areas probably occurred within California sagebrush scrub communities, while occurrences described as occurring within sandy washes were probably within Riversidean alluvial fan sage scrub communities (Sapphos 2001). Historically occupied habitat likely also included native grasslands (Meyer 2004). The interstitial spaces between bunchgrasses were likely occupied by annual forbs and geophytes, including various species of *Chorizanthe* (Keeley 1990).

At the two current known population locations, spineflower generally occurs within sparsely vegetated grassland and scrub communities and associated ecotones. At Ahmanson Ranch, spineflower is described as occurring along the interface between California sagebrush scrub and grassland habitats. This observed distribution may be the result of past dryland farming of the mesa top, which likely removed any spineflower growing in the farmed area (CDFG 2001). Past farming and livestock grazing practices are likely to have modified the vegetation at Ahmanson Ranch; therefore, it is not known whether this area was native grassland, coastal scrub, or a mix of both prior to European contact. At the Santa Clarita location, the majority of spineflower occurrences are within California sagebrush scrub and California annual grassland but also occur on agricultural land. Here, agricultural land refers to areas that were recently subjected to terracing and grubbing for agricultural purposes but that were not planted with actual crops or were planted with crops in the recent past. Spineflower also occurs within openings in southern coast live oak woodland, undifferentiated chaparral, and alluvial scrub. Sparsely vegetated areas with low overall cover of herbaceous vegetation and some bare ground are typical of existing spineflower sites at Ahmanson Ranch and at Santa Clarita, although spineflower has also been observed in areas of dense annual grasses.

San Fernando Valley spineflower appears to occur most often in areas with little or no competing vegetation. This has also been reported for other species of *Chorizanthe* (Davis and Sherman 1992; McGraw and Levin 1998; Kluse and Doak 1999; Coppoletta and Moritsch 2002). Preliminary studies within the project study area found no correlation between spineflower densities and vegetation type (e.g., native or non-native herbs) or ground cover (e.g., thatch, bare ground, litter) when analyzed at the level of mapped occupied polygons. The exception to this was a negative correlation with the percentage of native shrubs, indicating that shading may be an inhibitor of spineflower occurrence (Dudek & Associates 2006a). Studies conducted on the Santa Clarita population in 2007, an exceptionally dry year, found that compared to areas that typically contain spineflower (i.e., in years of average or above-average rainfall), areas containing spineflower in 2007 tended to have greater cover of bare ground, less cover of thatch, and thatch that was not as deep. In addition, the majority of co-occurring species in 2007 were non-native annual species, suggesting the similarity of ecological requirements and the potential that competitive effects of non-native plants may be especially important in years of below-average rainfall (Dudek 2007c).

Test-plot experiments at Ahmanson Ranch studied the effect of treatment combinations of vegetation removal and supplemental watering in both north- and south-facing plots by measuring mean number of plants, mean number of involucres, and mean plant size. Results indicated that maintaining subplots free of all competing vegetation produced spineflower plants of exceptional size and number of involucres by producing additional primary, secondary, and tertiary branching (Sapphos 2003c). The Sapphos study also indicated that vegetation removal increased the number of seeds produced per plant; however, this was the result of an increase in the number of flowers produced and not of an increase in seed set (Sapphos 2003c).

The Sapphos study results indicated that any combination of vegetation removal in which all vegetation other than spineflower was removed had no significant effect in the west-/northwest-facing plot. However, in south-facing plots, vegetation removal had a significant effect on the mean number of plants within a plot and on the number of involucres produced per plant. Thus, when vegetation was removed, the number of involucres and mean plant size were significantly greater on south-facing plots than north-facing plots. Between north- and south-facing plots, there were no significant differences in plant number, number of involucres, or mean plant size when vegetation was not removed (Sapphos 2003c).

In a second Sapphos study at Ahmanson Ranch, vegetation removal was accomplished using a weed-whip or herbicide (Roundup). Following treatment, the vegetation and duff were removed from the plots, and the plots were seeded with spineflower. The plots treated with the herbicide experienced greater spineflower growth and reproductive output compared to the weed-whipped plots (Sapphos 2003b). It is important to note that this outcome may have been influenced by rainfall conditions in 2003, when rain fell as late as May 9. This could have resulted in regrowth of annual grasses within the weed-whipped plots.

The results of the 2006 and 2007 pilot monitoring studies at the Santa Clarita location (Dudek & Associates 2006a–2006d; Dudek 2007c) and the studies summarized above indicate that spineflower occurrence is controlled by a combination of environmental conditions and competition. Spineflower tends to occur most often in open areas, particularly those lacking a

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dense shrub canopy. Observed occurrences in settings with disturbed soils (i.e., roadsides and burrows) could be interpreted as indicating that spineflower is a successional specialist, but the consistent occurrence from 2002 to 2015 in the same areas indicates that its distribution is more strongly environmentally controlled by factors such as soils, slope, and aspect.

1.6 Species Reproduction and Seed Dispersal

1.6.1 Reproduction

Spineflower flowers are protandrous, meaning that the anther sheds pollen before the stigma in the same plant is ready to receive the pollen, which limits the extent to which self-fertilization can occur within a flower. However, according to Jones et al. (2002, 2009), spineflower exhibits small flower size and a fruit set higher than expected for exclusively outcrossing systems (i.e., individual plants that must be pollinated by other plants), which indicates that spineflower is likely a facultative “selfer.”

Based on the results of the 2007 Spineflower Monitoring Pilot Study conducted on the Santa Clarita population, plant size was found to have a significant correlation with the number of involucres per plant (Dudek 2007c). Because spineflower produces a single seed per involucre, the number of involucres per plant is an indication of maximum reproductive output. In 2007, plant size (i.e., diameter) ranged from a few millimeters across to as large as 12 centimeters (4.7 inches) across. The number of involucres per plant generally reached as high as 300 involucres per plant.

1.6.2 Germination and Viability

Seed set, seed viability, and germination rates for spineflower have all been documented to vary considerably, but have not been documented to be low (RSABG 2000, 2001, as cited in Sapphos 2003b). There has been some reported evidence of enhancing seed germination rates with seed coat clipping, but germination rates have been shown to be inherently high. For example, seed germination tests conducted by Rancho Santa Ana Botanic Garden in 2015 reported germination rates between 78% and 97% (RSABG 2015). Further, seed germination occurred quickly and without pre-treatment, germinating within 1 week of stratification (RSABG 2015).

In the wild, FL*x* has documented spineflower seed germination at varying times of the year, including as early as January and as late as October, including in the middle of the summer following a rain event (FL*x* 2015). These observations suggest that, given the right conditions, at least some spineflower will germinate regardless of the time of year.

1.6.3 Pollinators

Most information regarding the pollination biology of spineflower in natural settings comes from studies carried out at Ahmanson Ranch in 2001 by Jones et al. (2002, 2009) and at the Santa Clarita location in 2004 by Jones et al. (2004, 2009). Field observations indicate that spineflower is visited by a diverse set of potential invertebrate pollinators, but that most visitors and total visits are represented by a smaller subset of taxa. Almost 50% of the visitors to spineflower were the native ant *Forelius mccooki* and flower beetles in the Melyridae family (Jones et al. 2009). Although *Forelius mccooki* and flower beetles were the most common visitors, over the entire blooming season flies (Diptera), at 45.5% of all recorded visits, dominated the actual total number of visits to flowers, followed by ants (32.5%) and beetles (16%). Bees, and especially European honeybee (*Apis mellifera*), were not common visitors to spineflower flowers during the entire blooming period at the Santa Clarita location. However, honeybees collected from Ahmanson Ranch were the only species carrying sufficient amounts of pollen for a complete pollinator analysis, where they were determined to have a high rate of floral constancy, with pollen loads ranging from 96% to 99% for 9 of 10 individuals. This high floral constancy indicates that honeybees are capable of being effective spineflower pollinators, even if they are not the most common visitors. More limited data for other species suggested they could be spineflower pollinators, but the data did not meet the criteria for a complete analysis. Of the non-honeybee visitors to spineflower flowers on Ahmanson Ranch, 56 different visitors carried one or more pollen grains of any plant species, of which 48 carried one or more spineflower pollen grains. Of the 17 *Forelius mccooki* collected, 13 carried one or more spineflower pollen grains, of which 9 carried only spineflower pollen and the other 4 carried mixed pollen loads.

Based on the field observations at Santa Clarita and Ahmanson Ranch, Jones et al. (2009) concluded that spineflower exhibits a generalist pollination strategy, with a variety of terrestrial and flying taxa visiting spineflower flowers, including ants, bees, beetles, and flies, appearing capable of effecting pollination with subsequent seed set.

1.6.4 Seed Dispersal

Little is known about dispersal of spineflower seeds. Trapping studies conducted at Ahmanson Ranch in September 1999 investigated the potential role of small mammals in spineflower seed dispersal (Sapphos 2001). Four rodent taxa were found in trap lines set within spineflower habitat: pocket mouse (*Chaetodipus* sp.), kangaroo rat (*Dipodomys* sp.), western harvest mouse (*Reithrodontomys megalotis*), and North American deermouse (*Peromyscus maniculatus*), all of which are common in shrubland and/or grasslands in Southern California. No spineflower seeds were found attached to the animals' pelage, and neither seeds nor seed heads were found in the cheek pouches of kangaroo rats or pocket mice. However, this is not surprising given that spineflower seeds may not disarticulate from the involucre for some months, which would

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potentially protect the seed from direct herbivory during that stage. In the field, involucres have been observed to attach to human skin, clothing, and shoes, suggesting potential for involucres containing seed to be carried away from the parent plant if they lodge on humans or other animals.

Based on spineflower seed germination tests conducted at Rancho Santa Ana Botanic Garden, it appears that the involucres may inhibit or delay germination. Two germination studies conducted in 1999 and 2000 of spineflower seeds still retained within the involucres resulted in germination rates of 34% and 30%. Subsequent germination studies conducted for spineflower seeds removed from the involucres resulted in germination rates of 65% to 100% (Wall 2004).

Ants may play a role in the dispersal of spineflower. LaPierre and Wright (2000) noted one species of harvester ant (*Messor andrei*) carrying spineflower flower parts containing seeds to nest sites, and spineflower parts were also evident in *M. andrei* midden piles. Harvester ants are capable of foraging for seeds as far as 100 meters (330 feet) from the nest, creating the possibility that seeds may be dropped along the way, where they may germinate later.

1.7 Seedbanks and Genetics

The appearance of significant new spineflower occurrences from year to year in the vicinity of Ahmanson Ranch and Santa Clarita is consistent with the presence of a seedbank. Ferguson and Ellstrand (1999) note that seedbanks are critical to maintaining genetic diversity among isolated populations of slender-horned spineflower, a close relative of the San Fernando Valley spineflower. In studies of slender-horned spineflower, current-year germinating plants were found to have greater genetic variation than seeds produced during the previous year, indicating that seedbanks make important contributions to genetics and population biology. Genetic variation within populations and within the species as a whole was found to be higher in slender-horned spineflower than is generally expected for annuals or endemics. Similar investigations of the genetic variation of the Santa Clarita and Ahmanson Ranch spineflower populations are currently being conducted. Early indications from an analysis of genetic diversity at the Ahmanson Ranch population is that selectively neutral genetic variation[5] is relatively low compared to a congeneric sympatric species (Turkish rugging; *Chorizanthe staticoides*) (Rogers 2016). Additionally, there is no evidence of polyploidy[6] in spineflower (Rogers 2016).

Until the results of the spineflower genetics study are known and fully analyzed in the context of this Introduction Plan, spineflower introductions near areas with extant spineflower (e.g., Potrero

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5 *Selectively neutral genetic variation* refers to genes that do not have adaptive value and effects on fitness but that can provide information about important processes such as gene flow, genetic drift, migration, and dispersal.

6 Polyploidy refers to more than two sets of homologous (paired) chromosomes. Evidence of polyploidy could complicate genetic analysis and could have implications for introductions using seed sources from different extant occurrences.

and San Martinez Grande) will use a spineflower seed source that is proximal to the introduction site (e.g., sites within 1,000 feet of the SCP Potrero Spineflower Preserve will only use seed originating from that preserve). While it is still unknown how diversifying the seedbank would affect extant spineflower occurrences, this conservative approach will minimize the risk of genetic contamination by reducing the potential for seed dispersal and pollination between plants from non-local sources and those within existing populations.

For proposed introduction sites that are distant from extant populations (e.g., Ventura–Simi, Castaic Mesa, Elizabeth Lake), a modified seeding approach that diversifies genetic variation may be used. Some research indicates that the potential for resilience might be enhanced at the beginning of a reintroduction by maximizing genetic variation from the source population (Clegg and Brown 1983, as cited in Pavlik 1996). Increased resilience is particularly desirable for spineflower introductions considering these proposed introduction sites have not supported spineflower for decades, or possibly never. Pavlik (1996) notes that the risk of breaking up co-adapted gene complexes is probably low in rare plants, and diversifying the genetics of the source seed could improve heterogeneity required for maximizing reproductive success and stress tolerance at introduction sites (DeMauro 1989, 1993; Barrett and Kohn 1991, as cited in Pavlik 1996). The apparent risk of this approach seems acceptably low, considering the upside of potentially improving resilience and reproductive success of introduced spineflower. Further, due to the substantial distance of proposed introduction sites from extant sites, this approach would not pose a risk to the genetic integrity of the extant populations.

1.8 Rationale for Success

Spineflower is currently known from a restricted range of environmental conditions. However, absence of spineflower at sites that appear to be otherwise suitable for the species does not necessarily indicate that they are not suitable for spineflower introduction; other historical environmental and/or anthropogenic factors may explain the current absence of the species. For instance, spineflower has likely been removed or displaced from some suitable habitat at the Ahmanson Ranch and the Santa Clarita locations by historical activities such as grazing and invasion of exotic annual grasses. Removal of these and other factors through the management measures proposed in this Introduction Plan may allow successful introduction or reintroduction of spineflower. Even in suitable habitat where incompatible activities do not currently exist, and the site is otherwise suitable for recolonization through seed dispersal, other factors may functionally preclude or delay natural colonization for many years. For instance, the site may not be close enough to extant populations to allow for a reasonable likelihood of seed transport by certain potential limited-mobility seed dispersers such as rodents and harvester ants. Intervention by seeding these areas with spineflower can be expected to result in successful introduction.

There is no information about whether spineflower may have occurred at the specific sites proposed for introduction under this Introduction Plan. Spineflower introduction sites under this Introduction Plan have therefore been chosen based on the best available scientific information regarding suitable habitat, including the various biotic and abiotic factors discussed in Section 1.5, Soil and Habitat Characterization, and the results of the Habitat Characterization Study (Appendix A).

1.8.1 Suitability of Spineflower for Introduction

Attempts to introduce other *Chorizanthe* species in other areas of California have been conducted, including introductions of Ben Lomond spineflower (*Chorizanthe pungens* var. *hartwegiana*), Sonoma spineflower (*C. valida*), and Orcutt's spineflower (*C. orcuttiana*).

Populations of the Ben Lomond spineflower have been successfully established through experimental research projects, revegetation, and restoration projects within the Santa Cruz Sandhills, the ecosystem to which this federally endangered species is narrowly endemic. Between 1998 and 2002, seed of the Ben Lomond spineflower, an annual, was sown in a series of small-scale experimental studies involving habitat manipulations designed to understand the species' responses to natural disturbance, interannual variability in precipitation, and exotic plant competition. Seed germination varied depending on the habitat conditions, but exceeded 70% in open habitat away from woody vegetation where the species naturally occurs (McGraw 2004a). In conditions most conducive to Ben Lomond spineflower plant growth, such as gopher mounds, the species experienced high survivorship and growth rates, with individual plants producing up to 5,000 flowers (McGraw 2004a).

Due in large part to Ben Lomond spineflower's high fecundity in areas of recent disturbance, large populations of the species have been established in restored sandhills habitat, including as part of work to revegetate former sand quarries. In fall 2014, Ben Lomond spineflower seed was sown at a rate of approximately 0.7 seeds/square foot (based on weight) into three completely denuded areas totaling 1.8 acres. The seed was part of a mix that included 20 additional native sandhills plant species. Preliminary analysis of data collected in spring 2016 revealed that, 2 years following treatment, the absolute cover of Ben Lomond spineflower ranged from 16.5% to 36.25% (mean=26.8, SE=5.5) (McGraw n.d.a) and Ben Lomond spineflower was among the most abundant and frequently observed (i.e., number of plots occupied) of all plant species (native or exotic) observed during the monitoring study (McGraw n.d.b). Although quantitative monitoring was not conducted in spring 2015, photo-monitoring of the sites suggests that Ben Lomond spineflower cover was less than 10% in the first year. Population growth combined with higher rainfall in 2016 accounts for the increase observed in Year 2 (McGraw n.d.a).

Orcutt's spineflower was the subject of the Recovery and Management of Orcutt's Spineflower (*Chorizanthe orcuttiana*) Final Report (Recovery Plan) prepared by Bauder (2000). Orcutt's spineflower occurs along the coast of San Diego County. It is restricted to isolated patches of sandy soils in openings of shrublands (Bauder 2000). Three extant populations were known at the time the Recovery Plan was prepared (Bauder 2000). More recently, the Chaparral Institute has been working on Orcutt's spineflower introduction at Torrey Pines State Park. Staff from the Chaparral Institute conducted surveys based on a predictive soil model and discovered several new occurrences (Hogan, pers. comm. 2016). They collected and successfully increased the seed count through seed bulking at Rancho Santa Ana Botanic Garden to obtain a resource for a reintroduction program (RSABG 2014). In early winter 2015, they spread seed in unoccupied areas that were mapped with suitable soils and supported suitable habitat. No supplemental water was provided during the growing season of 2015–2016, when rainfall was below average. Results of the experimental introduction have demonstrated only limited success to date, with only a few plants germinating in spring 2016, but continued seed introductions are planned for subsequent seasons (Hogan, pers. comm. 2016).

Sonoma spineflower occurs on sandy substrates at the Point Reyes National Seashore, where seedlings establish in areas that are relatively free from other competing native species (USFWS 2002). There is only one known extant natural population of Sonoma spineflower. Similar to San Fernando Valley spineflower, this population fluctuates annually, but the distribution has remained localized (USFWS 2002). Point Reyes National Seashore has made efforts to assist the recovery of Sonoma spineflower by sowing seeds in plots located near the existing population and at a historical occurrence. The reintroduction attempts have had varying results, with some introduction plots failing and others persisting at least several years (Ryan and Parsons n.d.). At one of the plots, Sonoma spineflower was documented expanding beyond the seeded plot (USFWS 2002). One of the earlier introduction attempts was made in 1999 at a historical occurrence on F Ranch, where it was documented several years later (as late as 2010) and presumably still exists. In their presentation, Ryan and Parsons describe four reintroduction attempts at 12 sites, with 8 of the 12 sites still supporting the species and 4 sites failing.

These introduction studies show that species of *Chorizanthe* can be successfully introduced, both into areas that were known to be previously occupied and areas that were judged to support suitable habitat but for which historical status was unknown. As additional evidence that spineflower has the ability to germinate and reproduce in unoccupied areas, Rancho Santa Ana Botanic Garden reported that an estimated 30 plants produced approximately 4,000 seeds in a gravel wildflower display bed in which 1999 seed accession chaff had been distributed after cleaning that year's seed collection (Sapphos 2002).

1.8.2 Introduction Site Selection

Spineflower locations, including distribution and areal extent, appear to be controlled by intrinsic environmental characteristics (e.g., soil type, slope, and aspect), while population densities are controlled by extrinsic environmental characteristics (e.g., rainfall) (Dudek 2010). Although extrinsic environmental characteristics cannot be easily modified, intrinsic factors have been evaluated to target introduction opportunities specific to spineflower occupation and persistence. Intrinsic and extrinsic environmental conditions will ultimately drive spineflower establishment and persistence; however, this spineflower introduction program is expected to improve site conditions for spineflower, thereby increasing the likelihood of species establishment and persistence within the introduction sites over the long term.

Because spineflower tends to occur in areas within a specific range of environmental conditions (see Section 1.5), careful site selection based on scientific analysis of occupied sites is a key factor in developing confidence for a successful introduction program. The approach used in this Introduction Plan is to determine sites that best meet the identified parameters that appear to favor occupation by spineflower and introduce the species at these sites. Site selection relied heavily on the results of the Habitat Characterization Study, which compared occupied and unoccupied areas within coastal scrub and annual grassland, to identify characteristics of occupied spineflower habitat (Appendix A). In addition to selecting what appear to be the most suitable sites, the approach in this Introduction Plan is to assist the spineflower during the early establishment period in order to help the introduced population develop a foothold through habitat enhancement, ultimately resulting in a self-sustaining and persistent population.

The existing spineflower populations display wide annual variation in abundance in response to extrinsic environmental factors, particularly annual rainfall totals and timing, and variations in plant size and vigor in response to competition from other native and non-native plants. Enhancement and management of the introduction sites are expected to contribute to overall spineflower persistence at introduction sites by providing additional areas for natural recruitment and potential increase in individual plant size and reproductive output, while reducing competitive pressure from other native and non-native species.

Observations of spineflower indicate that the species has the ability to tolerate, and possibly even to benefit from, some level of site disturbance, including both natural ecological and anthropogenic disturbances. Ecological disturbance from fossorial rodent activity was commonly noted among occupied plots during the Habitat Characterization Study (Appendix A). Spineflower in a particular locale near another occurrence may have the ability to recolonize after anthropogenic disturbance where appropriate conditions exist. For example, spineflower has been observed on land disturbed by past agricultural uses (e.g., terracing and grubbing). At the SCP Airport Mesa Spineflower Preserve within the Santa Clarita location, spineflower occurs on an old graded road

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bed. Spineflower occurrences are also present in annual grasslands that have been used for grazing for decades. Evidence of recolonization on previously disturbed sites provides reasonable confidence that spineflower may be successfully introduced and permanently take hold at previously unoccupied sites that otherwise appear to be suitable.

The combined factors of documented success with other *Chorizanthe* introductions (discussed in Section 1.8.1, Suitability of Spineflower for Introduction), spineflower tolerance for disturbance, the ability of the species to recolonize disturbed sites, and the accompanying enhancement program to aid establishment and persistence provide the rationale and optimism for successful implementation of the spineflower introduction program described in this Introduction Plan.

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2 DESCRIPTION OF THE SPINEFLOWER INTRODUCTION PLAN

This Introduction Plan provides guidelines for implementation of the spineflower introduction program. The goal is to establish a minimum of two new self-sustaining and persistent spineflower populations at Additional Conservation Areas. The measures will increase the resiliency of the existing populations and enhance the redundancy of representation of the species.

The Introduction Plan will be implemented with an adaptive management approach that may be modified based on new research and on the results of seeding trials. The program is set up with an initial 10-year maintenance and monitoring period for each introduction site that will include enhancement, introduction, maintenance, and monitoring efforts. However, the intent of the program is to continue conservation efforts for enhancement of spineflower habitat into in-perpetuity management beyond this initial maintenance and monitoring period.

2.1 Project Participants

The following section identifies project participants that will be involved in some aspect of planning, implementation, monitoring, or adaptive management of the Introduction Plan. The participants identified in this section may also be participants in the SCP.

Sponsor: The Sponsor (Newhall Land) will be financially responsible for all aspects of implementing this Introduction Plan and will serve as the point of contact for permission to gain access to the project sites. The Sponsor will also be a member of the Spineflower Adaptive Management Working Group (as detailed in the following section).

Regulatory Agencies: CDFW and USFWS will be provided the opportunity to advise and provide technical expertise to Newhall Land to aid in a successful outcome of the Introduction Plan. The Regulatory Agencies will also be members of the Spineflower Adaptive Management Working Group and will contribute to guiding the management, monitoring, and planning activities of this Introduction Plan.

Scientific Experts: An advisory group of scientific experts will be provided the opportunity to advise and provide technical expertise on design and application, data interpretation, and implementation of adaptive management measures. The scientific experts will be a part of the Technical Advisory Subgroup of the Spineflower Adaptive Management Working Group.

Project Biologist: A qualified biologist or restoration ecologist ("Project Biologist") shall have a bachelor's degree or higher in biology, botany, or a similar field; be intimately familiar with spineflower ecology, local plant communities, invasive plant and animal control methods, and biological data collection and assessment; and have verifiable experience (a minimum of 3 years) performing similar types of environmental monitoring, reporting, and natural lands management.

The Project Biologist shall have experience in rare plant introduction and/or restoration and will be responsible for providing supervision and oversight of the implementation, maintenance, and monitoring of the Introduction Plan. The Project Biologist will also be responsible for sourcing appropriate plant materials, determining supplemental watering needs, and conducting pre-construction surveys/species relocation during implementation. The Project Biologist will have authority to modify the work, in consultation with Newhall Land, CDFW, and USFWS, if problems with the implementation of the Introduction Plan are observed.

Biological Monitor: Under the direction of the Project Biologist, a qualified biologist or habitat restoration specialist with at least 3 years of experience in monitoring rare plant populations will be the designated Biological Monitor and will be responsible for providing biological monitoring during the implementation and maintenance of the Introduction Plan.

Landscape Contractor: A qualified, licensed Landscape Contractor with experience working in native habitats with rare plants will be responsible for implementing and maintaining the spineflower introduction sites as described in this Introduction Plan.

Nursery Manager: A Nursery Manager (e.g., RSABG) will be responsible for storing and propagating spineflower seed for use in the Introduction Program. The Nursery Manager shall be authorized by CDFW to provide seed storage for rare, threatened, and endangered California native plant species.

Land Manager: The Land Manager (e.g., the Center for Natural Lands Management or approved similar entity) will be responsible for managing the introduction sites after the initial 10-year implementation phase is complete and the ongoing (in-perpetuity) management has begun. The Land Manager will assign a qualified biologist approved by CDFW and USFWS to oversee all environmental monitoring and ensure that the monitoring and management activities outlined herein are carried out.

2.2 Spineflower Adaptive Management Working Group

The SCP includes an Adaptive Management Working Group that guides the management, monitoring, and planning activities of the adaptive management program in the SCP. The Spineflower Adaptive Management Working Group consists of the Land Manager (e.g., the Center for Natural Lands Management), Resource Agency staff (CDFW and USFWS), and scientific experts, and includes a Technical Advisory Subgroup that is specifically responsible for addressing technical scientific issues associated with management, monitoring designs, and data analysis under the SCP. The Technical Advisory Subgroup includes scientific experts, such as Jodi McGraw, PhD (Jodi McGraw Consulting); Nathan Gale, PhD (FL*x*); Anuja Parikh, PhD (FL*x*); and Dudek's scientific staff. Newhall Land will seek input from and consult with members of the Spineflower Adaptive Management Working Group and the Technical Advisory Subgroup during planning and implementation of this Introduction Plan, as well as at least annually during the implementation period. The Spineflower Adaptive Management Working Group shall be responsible for evaluating completed management actions and defining explicit objectives for future management actions.

2.3 Seeding Trials

The Introduction Plan includes the implementation of seeding trials to test various seeding application methods that can be applied on a broader scale during implementation of this Introduction Plan. The intent of the seeding trials, which have already begun at the Potrero Preserve Expansion and San Martinez Grande Preserve Expansion – Los Angeles County Additional Conservation Areas, is to (1) evaluate spineflower performance under various treatments and (2) preliminarily evaluate spineflower performance at identified introduction sites prior to broader-scale introductions.

2.3.1 Goals and Objectives of the Seeding Trials

The primary goals of the seeding trials are to determine the most effective methods to establish spineflower and to evaluate relative spineflower performance (e.g., seedling establishment, survivorship, growth, and reproduction) at potential introduction sites prior to broad scale introduction attempts. The seeding trials are designed to evaluate factors that may influence suitability of habitat for spineflower and examine the effectiveness of habitat treatments designed to establish spineflower occurrences. Specifically, the seeding trials will test the independent and interactive effects of potential treatment options such as weed suppression, supplemental watering, soil compaction, topsoil scraping, and the use of salvaged spineflower topsoil. In addition to the goal of determining the most effective seeding methods and treatments, the seeding trials are intended to function as a pilot for various sites selected for spineflower introduction, whereby the relative success of the seeding trials will help prioritize the level of effort to establish spineflower for each site.[7]

Not surprisingly, the site-specific data collected at the proposed introduction sites represent a range of biotic and abiotic factors. While this Introduction Plan contains a careful analysis of these factors as they relate to occupied habitat within the Santa Clarita population, these factors may not necessarily be fully applicable to spineflower habitat suitability when extrapolated to new areas outside of the range of the Santa Clarita population and in different ecoregions.

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7 Regardless of the results of the seeding trials, spineflower introduction will occur at multiple Additional Conservation Areas and will occur on a minimum of 10 acres, combined, across the Additional Conservation Areas.

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Additionally, the variation of biotic and abiotic factors at the proposed introduction sites will likely affect spineflower performance in different ways across various sites that cannot be fully predicted based on a habitat study of the Santa Clarita population. Therefore, this Introduction Plan provides for pilot seeding trials at proposed introduction sites prior to broad scale attempts at introduction to get a sense of spineflower performance, and with an overarching purpose to focus resources in areas with the greatest potential to achieve the goals of this Introduction Plan. The results of the seeding trials will also be used to inform the selection of success criteria for introduction sites, as described in Chapter 4, Implementation Plan.

The selection of specific locations for seeding trials is based, in part, on the prioritization matrix included in this plan, which scores sites based on how well they meet the defined parameters from the Habitat Characterization Study (Appendix A). The test plots will be monitored for a minimum of 2 years after seeding to determine seedling survival/density, phenology, and species reproductive success for the various treatments. A summary of the seeding trials will be prepared annually while the trials are ongoing, with results compiled and analyzed for review by the Technical Advisory Group.

2.3.2 Preliminary Results of Initial Seeding Trial

An initial seeding trial was initiated in fall 2016. The seeding trial was designed for a 2-year period, but preliminary results from the first growing season are summarized here. Details of the methods and experimental design of the 2016 seeding trial are described in the San Fernando Valley Spineflower Habitat Manipulation and Seeding Experiment (Appendix B). The initial seeding trial was conducted at 10 locations near the SCP Potrero Spineflower Preserve and San Martinez Grande Spineflower Preserve that were identified as suitable for spineflower due to the presence of habitat indicators based on the results of the Habitat Characterization Study. The initial seeding trial consisted of small-scale manipulations of habitat treatments and seeding methods to evaluate how they influence aspects of spineflower individual plant performance. Habitat treatments included soil compaction, weeding, and supplemental watering. Seeding methods included broadcast seeding and applying salvaged seedbank topsoil. To assess the treatment effects on spineflower performance, spineflower density, plant size, and inflorescence canopy width were measured. Preliminary results of the 2016 seeding trial are detailed by Dr. Jodi McGraw in Appendix C.

The most recent census of the plots in late March 2017 revealed that spineflower successfully established from both broadcast seeding and salvaged seed topsoil in all 10 test plot locations. Mean spineflower density was similar among broadcast seeded plots (mean = 7.4, SE = 0.89) and topsoil addition plots (mean = 9.3, SE = 2.0) (Appendix C).

Among the plot treatments, soil compaction prior to seeding unexpectedly showed an adverse effect, significantly reducing spineflower density by 63%. This result was unexpected, given that spineflower is often observed on disturbed and compacted soils such as those along dirt roads. Weed control appeared to promote spineflower survivorship (but only in uncompacted plots), with a beneficial effect on spineflower density between February and March. Due to the high rainfall during the 2017 growing season, the irrigation treatment was not initiated until mid-April and therefore did not have an effect on spineflower density in late March.

A census will be conducted in early June to measure final spineflower density, size, flower production, and seed set for the first growing season. These and other spineflower performance variables will be analyzed to evaluate the independent and interactive effects of the habitat treatments and seeding treatments and further explore the role that varying abiotic and biotic conditions of habitat in the introduction sites may be playing in influencing spineflower performance. Plots will also be monitored in 2018 to evaluate whether additional spineflower cohorts establish from dormant seed from the 2016 seeding and/or seed produced in 2017.

The final results of this initial study will be used to inform the design of future small-scale (or pilot) introduction trials, including evaluating additional treatments to promote spineflower population establishment during introductions.

2.4 Overview of Introduction Methods and Implementation Procedures

This section provides an overview of the general methods for habitat enhancement and spineflower introduction. Seeding trials will be implemented at potential introduction sites within each Additional Conservation Area. Seeding trials will consist of a series of test plots to evaluate spineflower performance under various treatment scenarios at the introduction sites, similar to the methods used for the initial seeding trials implemented in 2016. More specific methods for introducing spineflower across a broader range of the introduction sites will be determined after the results of the initial seeding trials are reviewed and the most effective methods are identified.

Site preparation will be a critical component of the spineflower introduction approach. Site preparation methods will vary by site, depending on the conditions and level of evident disturbance. Weeds are prevalent throughout each of the study areas, including within the selected introduction sites. Weeds are primarily non-native annual forbs and grasses. Therefore, habitat enhancement prior to spineflower seed application will include controlling weeds to below a 10% absolute cover threshold and minimizing the weed seedbank.

In relatively undisturbed introduction sites that support a native habitat structure and undisturbed soils, but still contain weeds, weed control may occur immediately prior to spineflower seed application. In heavily disturbed sites with abundant non-native vegetation, a series of weed reduction cycles may be implemented over the course of a few weeks to as much as a full growing season. Heavily disturbed sites may also undergo minor topographic corrections where former land use practices have altered soil surface conditions (e.g., agricultural fields, fire breaks, road cuts).

An additional component of the site preparation methods may be the use of salvaged topsoil collected from areas that supported spineflower within the proposed Newhall Land development footprint. Salvaging soils that supported spineflower should also result in the transfer of at least a portion of the spineflower seedbank, which is assumed to be present in the salvaged soils. Further, placing salvaged soil at the introduction site should increase the chance that the site will provide suitable soil conditions for persistence of the plants because all associated soil, small rocks, and biomass in which spineflower is known to occur will be present.

If available, salvaged topsoil will be used by collecting the seedbank topsoil (the top 0.5 inches to 1 inch), followed by collecting 8–10 inches of the subsoil below the top 1 inch. At the selected introduction site (a disturbed location), the surface soils will be excavated to a depth of approximately 10 inches to prepare a receptor site for the salvaged subsoil and seedbank topsoil. The subsoil will be spread first, followed by the seedbank topsoil. The surface contours will be matched at the tie-in points of the receptor site so the receptor site follows the natural contours. Alternatively, the salvaged soils may be mounded on the existing grade, and contoured to mimic natural topography, with the subsoil underlying the seedbank topsoil.

Seed application will occur following successful site preparation. The seed source may be a combination of seed collected from the wild under the SCP conservation program and seeds bulked at Rancho Santa Ana Botanic Garden (Appendix D, San Fernando Valley Spineflower Seed Collection Report). Seed will be applied by hand broadcasting coupled with raking, drill seeding, or other method determined to be effective during the experimental seeding trials. Successive years of seeding (e.g., over the first 3–5 years) will be conducted to broaden the genetic base of the introduced population.

Studies conducted at the Santa Clarita location in 2007 and referenced in the SCP found that occupied spineflower areas typically displayed higher percentages of bare ground and less thatch accumulation (Dudek 2010). Introduction sites will be managed to minimize competition from native shrubs and non-native species. Introduction areas initially will not be planted with native shrubs, so that increased areas of bare ground are available for natural spineflower expansion and recruitment. Component species of occupied spineflower habitat, such as native grasses and forbs and sparse shrubs, will be added after the species has had the opportunity to establish (e.g., after 2–3 years). These component species will also enhance habitat for pollinators and potentially for seed dispersers.

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During the first growing season after seed introduction, if natural rainfall is not adequate to support maturation of the germinated plants, supplemental watering may be provided to encourage the introduced plants to produce seed in order to increase the resident spineflower seedbank at the new sites. Supplemental watering will be delivered through a water truck rather than a permanent point of connection to a live water line to minimize the potential for the introduction of Argentine ants (*Linepithema humile*).[8]

Weed control will likely be necessary to reduce competition to establishing spineflower plants, and is expected to be one of the key maintenance measures in the early stages of the introduction program. The method of weed control will be based on the most effective method for the species being targeted and the stage of plant development, as well as the method that is least damaging to emerging spineflower. Weed control measures may include a combination of hand removal, mechanical removal (e.g., cutting with weed whip machines, hoeing), and herbicide application as deemed appropriate for the particular species, presence or lack of spineflower, and time of year. During the growing period, weed control will likely consist of mechanical removal with line trimmers, which minimizes soil disturbance while minimizing the production of weed seeds.

All seeded areas will be physically marked, signed, and fenced for protection where necessary to protect seeded areas from public access, adjacent grazing or ranching uses, or other incompatible uses.

8 Argentine ants are not considered to be a significant long-term risk to spineflower at the introduction sites because they are all well separated from habitats supporting potential source populations such as urban development. Nonetheless, the Biological Monitor will assess whether Argentine ants are occurring at introduction sites and appropriate control measures consistent with the Argentine Ant Control Plan for Newhall Ranch (Dudek 2014) will be implemented in the event they occur.

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3 ADDITIONAL CONSERVATION AREA SITE DESCRIPTIONS

This section describes the process used to select the Additional Conservation Areas and the physical, chemical, and biological properties of those areas compared to sites occupied by spineflower. The general process included first selecting potential introduction areas based on a review of general areas in the historic range of spineflower that still contained potential habitat, and then evaluating each of these areas in further detail to determine potential introduction sites.

3.1 Additional Conservation Area Site Selection Process

General areas to evaluate as Additional Conservation Areas were determined based on proximity to extant spineflower populations, proximity to extirpated historical locations, availability of undeveloped open space, surrounding land uses, and land ownership. Some areas were considered and initially evaluated, but rejected due to lack of conserved open space, unsuitable conditions, or untenable land ownership situations. Areas considered but rejected include three extirpated locations, including Ballona wetlands, Chatsworth Preserve, and Rancho Lomas de Santiago near Irvine Lake. Each of these areas was rejected due to proximity to development (Ballona wetlands and Chatsworth), highly disturbed areas or areas subject to ongoing development (Chatsworth), or untenable land ownership (Rancho Lomas de Santiago).

Once general study areas were identified, the first step of the site selection process included using GIS to develop a model of potentially suitable spineflower introduction locations within the open areas described previously. Inputs into the model are based on the approximate range of abiotic factors present where spineflower currently exists or has been documented in the past. The factors incorporated into the GIS model included the following:

1. Slope (between 0° and 30°)
2. Southerly aspect (between 120° and 240°)
3. Elevation (below 1,500 feet amsl for sites where elevations below this value exist)

Elevation was set at a maximum of 1,500 feet amsl for locations where elevations below this value exist, including the Potrero and San Martinez Grande Preserve Expansion locations and the Castaic Mesa location, because 1,500 feet amsl is the maximum elevation of all extant spineflower occurrences, as well as all known extirpated occurrences, other than Elizabeth Lake. This approach was used in order to prioritize search efforts in areas considered to have the highest potential suitability for spineflower introduction.

Locations that lie entirely above 1,500 feet amsl are considered potentially suitable for spineflower based on the voucher record for the Elizabeth Lake location, which is located at a much higher elevation (Appendix E, San Fernando Valley Spineflower Potential Off-Site

Introduction/Voucher Specimens Research). The historical Elizabeth Lake herbarium record includes collections from approximately 3,300 feet amsl, which is the only documented and confirmed spineflower occurrence higher in elevation than 1,500 feet amsl. For locations that lie entirely above 1,500 feet amsl, elevation was not used in the GIS model to identify potential introduction sites but was used as one factor in comparing the potential sites that were identified with potential sites in other Additional Conservation Areas.

Using the GIS model, several sites within each location were selected to investigate soils, vegetation, litter/thatch, species composition, site disturbance, and soil compaction. The sampling sites were selected based on a desktop review and initial field reconnaissance to visually observe the site conditions. Sites that generally fit the GIS-modeled selection criteria as well as appropriate site characteristics (primarily based on a visual assessment of habitat and vegetation density) by species experts (Nathan Gale and Anuja Parikh from FL*x*) were selected for evaluation in greater depth (Appendix A). The selected site locations are identified on Figures 6-1 through 6-6.

Based on the field evaluation, sites that appeared to meet the visual characteristics of spineflower occupied habitat were delineated (Figures 6-1 through 6-6). Factors considered while delineating suitable sites were based on the results of the Habitat Characterization Study and are described in Appendix F, Evaluation of Prospective Introduction Sites for the San Fernando Valley Spineflower. Larger sites were assigned more than one sampling plot, and each plot was evaluated independently. The same sampling procedure that was used for the Habitat Characterization Study was used to collect the field data for the selected potential introduction sites. A 5-by-5-meter (16-by-16-foot) sampling area was randomly placed within sites that appeared potentially suitable from visual investigation. Nathan Gale and Anuja Parikh of FL*x*, who have been conducting surveys for spineflower on Newhall Land property since 1999, conducted the site sampling. The data collection form used for site sampling is provided in Appendix G. Dudek biologist Andy Thomson collected soil samples and measured compaction at each of the sampling sites. Soil samples were collected from the top 6 inches within the vertical soil profile (0–6 inches). Compaction was measured in five randomly sampled locations across the sampling plot. All sampling plot location corner points were mapped with a GPS unit.

Using the biotic and abiotic factors measured for each site, Dr. McGraw (Jodi McGraw Consulting) analyzed the data relative to comparable data collected in 2014 for the Habitat Characterization Study. A logistic regression was combined with an ecological model to select variables that appeared to be the most predictive of spineflower occupied habitat. The data were analyzed in the context of all known occurrences at the Santa Clarita location. The statistical range, mean, and standard deviation were calculated for all samples collected from occupied sites (n=51). Variables found to be significant in the logistic regression differentiating occupied and unoccupied sites were laid out in a matrix, and each variable was scored. The 11 variables included in the matrix include slope, aspect, elevation, silt content, pH, organic matter,

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ammonium nitrate, soluble potassium, soluble calcium, manganese content, and native annual forb richness. The full data set in matrix format is included in Appendix H, Soil Test Results (2016 and 2017). For all variables except elevation, no weighting was applied to the variables, as the relative importance of one variable over another is unknown as it relates to occupied spineflower habitat. Variables received a score of 1 if they fell within the range of occupied sites, and a score of 0 if they fell outside the range. For elevation, because the predominance of occurrence data is for elevations below 1,500 feet amsl, and no extant spineflower is known to occur above this elevation, a slight preference was given to sites below 1,500 feet amsl by assigning a value of 1 to sites below 1,500 feet amsl and a score of 0.5 to sites above 1,500 feet amsl but below 3,500 feet amsl.

3.2 Additional Conservation Area Site Characteristics

3.2.1 Soils and Geologic Conditions

Table 4 summarizes the mapped soil types and geologic conditions at the study areas. The Potrero Preserve Expansion and the San Martinez Grande Preserve Expansion (Ventura and Los Angeles Counties) are located in soils classified as Castaic-Balcom silty clay loams (USDA 2017). There are some variations in percent slopes of this soil classification, but otherwise the sites all occur on the same soil unit. Likewise, the nearby occupied spineflower areas within the San Martinez Grande and Potrero Spineflower Preserves are underlain by the same soil unit. The Castaic-Balcom complex consists of almost equivalent proportions of each soil type (~40%–50% each), with approximately 10%–15% composed of other soil types such as Gaviota, Saugus, Badland, Nacimiento, and San Benito at proportions estimated at 3%. The typical profile of the Castaic-Balcom series is silty clay loam to a depth of approximately 28 inches, where it transitions to weathered bedrock. Both Castaic and Balcom soils are well drained with a very high runoff class.

Table 4
Soils and Geology of Proposed Introduction Sites

Additional Conservation Area	Soil Types	Geology
San Martinez Grande Preserve Expansion – Los Angeles County	Castaic-Balcom silty clay loams	Fine-grained tertiary formations of sedimentary origin
San Martinez Grande Preserve Expansion – Ventura County	Castaic-Balcom silty clay loams	Fine-grained tertiary formations of sedimentary origin
Potrero Preserve Expansion	Castaic-Balcom silty clay loams	Fine-grained tertiary formations of sedimentary origin

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Table 4
Soils and Geology of Proposed Introduction Sites

Additional Conservation Area	Soil Types	Geology
Castaic Mesa	Riverwash Ramona loam Terrace escarpments Metz loam Saugus loam	Alluvial wash and alluvial valley deposits Coarse-grained formations of Pleistocene age and younger; primarily sandstone and conglomerate old alluvial valley deposits
Elizabeth Lake	Chino loam Millsholm rocky loam Hanford coarse sandy loam Vista coarse sandy loam Ramona sandy loam	Alluvial fan and alluvial valley deposits Cretaceous and pre-cretaceous metamorphic formations of sedimentary volcanic origin Coarse-grained tertiary age formations of sedimentary origin Fine-grained tertiary formations of sedimentary origin

The soils at the Ventura–Simi site are also a silty clay loam, similar to San Martinez Grande and Potrero. However, at the other sites, soils are more variable and consist of granitic soils, loams, rocky loams, and sandy loams (Elizabeth Lake) and loams, riverwash, and terrace escarpments (Castaic Mesa).

The Potrero and San Martinez Grande introduction sites are underlain by two primary geologic formations: Pleistocene alluvial deposits and Pliocene Pico Formation. These formations are a subset of the geologic formations underlying existing SCP spineflower preserves. The old alluvial valley deposits are moderately indurated gravel, sand, and silt terrace deposits that, depending on age, can have pedogenic soil formation. The Pico Formation is a marine clayey and sandy siltstone locally interbedded with fine-grained sandstone. Spineflower introduction sites located on the Pleistocene alluvial deposits satisfy the generic condition observed in previous studies that spineflower are typically associated with alluvial deposits of riverine systems (Sapphos 2000). Similarly, proposed spineflower introduction sites on the Pico Formation could overlie bedding contacts within the Pico Formation and areas where the Pico Formation is exposed at the surface. Thus, geologically, the proposed spineflower introduction sites at Potrero and San Martinez Grande are similar to the existing SCP spineflower preserve locations.

The Castaic Mesa area is underlain by active stream channel gravels and sands, Quaternary age terrace and alluvial fan deposits, and the Plio-Pleistocene age Saugus Formation. The active stream channel gravels and sands are unconsolidated deposits which are transported by surface water flow in Charlie Canyon, which is a small tributary canyon to Castaic Creek. The Quaternary terrace and alluvial fan deposits are also unconsolidated gravels and sands, which are primarily derived from crystalline basement rocks, that were deposited by streams in the late

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Pleistocene (Dibblee 1996). The Saugus Formation is typically light-gray to reddish-brown conglomerate, sandstone, and siltstone (Dibblee 1996). This formation was deposited in a fluvial environment and has been mildly indurated since deposition.

The Ventura–Simi area is underlain by the Pliocene age Towsley Formation and the Miocene age Sisquoc Shale. The Towsley Formation has two members, consisting of light-gray to tan sandstone and gray micaceous silty claystone and siltstone (Dibblee 1992). The sandstone member is coherent to semi-friable and contains local conglomerate. This member interbeds with the gray, micaceous silty claystone member that that commonly contains gypsum. The Sisquoc Shale is a dark-gray to brownish-gray crumbly shale that contains some thin-bedded semi-siliceous layers (Dibblee 1992). Gypsum is found in fractures in the Sisquoc Shale.

The Elizabeth Lake area is underlain by active alluvial gravel, sand, and clay, the Pliocene age Anaverde Formation, the Cretaceous age granitic rocks and the late Mesozoic or older Pelona Schist. The Anaverde Formation is a terrestrial fluvial and lacustrine sandstone, likely deposited in a lake or playa environment (Dibblee 2002). Typically gray-white to tan in color, the Anaverde Formation is locally conglomeratic, with pebbles or cobbles of granitic rocks. Fine-grained sandstones within the Anaverde contain concretions and locally thin interbeds of shale. The Cretaceous age granitic rocks are light-colored plutonic igneous rocks (Dibblee 2002). The granitic rocks have been fractured but are coherent (Dibblee 2002). The Pelona Schist is a foliated mica schist that contains muscovite, biotite, and, locally, quartz veinlets (Dibblee 2002).

3.2.2 Summary of Site Characteristics

The site characteristics that were evaluated for determining potential suitability are included in Table 5. The descriptions and metric scores in Table 5 provide an overview of the general character of the introduction site study areas. Note that if there were multiple samples collected for a particular metric within the same potential introduction site, the values reported in this table are averaged for that site, because the intent is to provide a general summary of site characteristics.

3.3 Site Selection Results

Table 6 displays the results of the introduction site suitability in a scored matrix of site variables. Site suitability in this context refers to the relative proportion of variables that fell within the range of spineflower occupied sites overall throughout the Santa Clarita location. The sites are sorted from most similar on the top to least similar on the bottom, based on the scoring method described above. Note that the scoring is specific to the sampling plot, rather than the general study area, with some potential introduction areas having more than one sampling plot (depending on size). Therefore, in some instances (e.g., Introduction Area A), specific sampling plots within the study site scored better than others.

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Sites that will be initially selected for spineflower introduction are those that are most similar to spineflower occupied sites at the Santa Clarita location (e.g., sites with a score of 9 or higher). However, additional sites that appear to be less similar, but still contain several features or characteristics that have been determined to be present and statistically significant at occupied sites, are also identified in this Introduction Plan as potential introduction sites. Retaining these additional sites for possible future use ensures that the pool of potential sites to introduce spineflower covers a wide range of potentially suitable habitat conditions. Inclusion of these additional sites also helps address the current uncertainty about species habitat requirements and future habitat conditions (including from climate change).

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Table 5
Site Characteristics Evaluated at Proposed Introduction Sites

Location	Site	Vegetation Type	Slope (degrees)	Aspect (compass bearing)	Elevation (feet amsl)	Soil Texture	Soil Compaction (psi)	pH	Organic Matter (%)	Native Annual Forb Richness (no. species)	Total Vegetative Cover (%)	Disturbance (% of area)	Disturbance Type	Micro-topography
San Martinez Grande – Los Angeles County	F	Coastal scrub	14	141	1,401	Silty loam	215	7.0	1.5	5	73	13%	Animal digging/ burrows, trails	Convex
San Martinez Grande – Los Angeles County	S	Annual grassland	16	162	1,055	Silty loam	253	6.7	1.7	2	70	6	Animal digging/ burrows, grading	Convex
San Martinez Grande – Los Angeles County	T	Annual grassland	18	135	1,208	Silty loam	195	6.6	2.1	1	68	13	Animal digging/ burrows, trails	Linear
Potrero	A	Annual grassland	10	150	1,045	Silty loam	277	6.4	3.0	3	92	5%	Animal digging/ burrows, trails, agricultural use	Convex
Potrero	B	Annual grassland	21	163	1,050	Silt	155	7.0	2.6	2	83	5%	Animal digging/ burrows, trails	Convex
Potrero	C	Annual grassland	17	118	1,049	Silty loam	200	6.5	1.6	1	85	3%	Animal digging/ burrows	Convex
Potrero	D	Coastal scrub	20	155	984	Silt	210	7.5	1.6	1	65	8%	Animal digging/ burrows, trails	Convex
Potrero	E	Annual grassland	20	158	1,516	Silt	150	7.3	2.6	0	85	15%	Animal digging/ burrows	Convex
Potrero	P	Coastal scrub	11	145	1,006	Silty loam	265	6.7	1.9	1	80	5	Animal digging/ burrows, trails	Convex
Potrero	Q	Coastal scrub	24	210	1,054	Silt	200	7.1	1.4	0	60	15	Animal digging/ burrows, trails	Convex
Potrero	R	Annual grassland	17	190	1,020	Silt	285	6	2.1	1	85	17	Animal digging/ burrows, trails	Linear
Castaic Mesa	CM2-1	Annual grassland	3	178	1,407	Sandy loam	300	6.3	2.3	7	100	0.5	Small animal tracks	Convex
Castaic Mesa	CM1-1	Annual grassland	12	193	1,409	Loam	300	6.5	2.4	9	99	3	Animal trail across plot	Convex
Castaic Mesa	CM3-1	Coastal scrub	2	173	1,361	Loam	300	6.1	1.9	10	75	100	Ridge appears previously graded; small animal hole	Undulating pattern
Castaic Mesa	CM7-2	Annual grassland	8	173	1,338	Sandy loam	300	5.7	2.1	11	90	100	Old abandoned road edge of mesa, with animal holes	Undulating pattern
Castaic Mesa	CM8-1	Annual grassland	2	198	1,288	Sandy loam	300	6.2	1.5	10	85	100	Area previously graded/cleared for beehives	Linear
Castaic Mesa	CM2-2	Annual grassland	2	183	1,397	Sandy loam	300	6.2	1.8	9	95	3	Animal digs/ mounds, trails	Convex
Castaic Mesa	CM7-1	Annual grassland	3	183	1,358	Sandy loam	300	6.2	2.4	7	97	100	Mesa top has been previously disked	Linear
Castaic Mesa	CM8-2	Annual grassland	12	173	1,273	Sandy loam	300	6.7	1.7	10	85	100	Old abandoned graded road, animal hole	Undulating pattern

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Table 5
Site Characteristics Evaluated at Proposed Introduction Sites

Location	Site	Vegetation Type	Slope (degrees)	Aspect (compass bearing)	Elevation (feet amsl)	Soil Texture	Soil Compaction (psi)	pH	Organic Matter (%)	Native Annual Forb Richness (no. species)	Total Vegetative Cover (%)	Disturbance (% of area)	Disturbance Type	Micro-topography
Castaic Mesa	CM9-1	Coastal scrub	5	113	1,239	Sandy loam	300	6.2	1.9	13	95	100	Old reveg road, animal holes	Linear
Castaic Mesa	CM10-1	Annual grassland	1	183	1,215	Sandy loam	205	6.2	2.0	13	97	3	Animal holes, mounds	Linear
Castaic Mesa	CM10-2	Annual grassland	11	183	1,273	Clay loam	275	6.4	2.2	9	70	0	No disturbance	Linear
Castaic Mesa	CM6-1	Coastal scrub	1	163	1,134	Loamy sand	270	6.7	1.2	5	80	3	Animal digs, trails	Linear
Castaic Mesa	CM5-1	Coastal scrub	1	163	1,137	Loamy sand	290	6.5	0.6	6	70	3	Old animal digs/ mounds	Linear
San Martinez Grande – Ventura County	G	Coastal scrub	9	191	140	Silty loam	265	6.4	1.6	5	75	13%	Animal digging/ burrows, trails	Linear
San Martinez Grande – Ventura County	H	Annual grassland	20	158	1,011	Silt	185	7.4	2.1	4	78	18%	Animal digging/ burrows, trails	Convex
San Martinez Grande – Ventura County	I	Annual grassland	13	168	1,168	Silty loam	165	6.5	1.9	4	85	10%	animal digging/ burrows, grading	Linear
San Martinez Grande – Ventura County	J	Annual grassland	22	161	1,238	Silt	130	7.2	2.8	2	88	15%	Animal digging/ burrows, trails	Linear
San Martinez Grande – Ventura County	O	Coastal scrub	26	145	1,242	Silty loam	210	6.5	3.2	2	60	20	Animal digging/ burrows	Convex
San Martinez Grande – Ventura County	U	Coastal scrub	18	140	1,706	Silt	220	6.3	2.7	4	85	10	Animal digging/ burrows, trails	Linear
Ventura–Simi	VS2-1	Annual grassland	6	183	2,628	Silty loam	290	5.8	5.7	4	80	3	Cow prints	Convex
Ventura–Simi	VS6-2	Annual grassland	14	203	2,920	Silty loam	200	6.3	6.9	4	65	3	Cow prints	Linear
Ventura–Simi	VS6-3	Annual grassland	11	213	3,016	Silty loam	155	6.3	6.7	7	65	5	Cow prints, grazing, animal holes	Convex
Ventura–Simi	VS6-4	Annual grassland	11	173	3,000	Silty loam	245	6.9	9.5	5	95	1	Cow prints, grazed	Linear
Ventura–Simi	VS1-1	Annual grassland	9	153	2,609	Silty loam	260	6.1	4.6	2	95	3	Cow prints	Linear
Ventura–Simi	VS3-1	Annual grassland	12	188	2,731	Silty loam	240	7.3	5.0	4	70	1	Cow prints, pies	Convex
Ventura–Simi	VS3-2	Annual grassland	20	218	2,779	Silty loam	220	6.3	6.2	3	75	3	Cow prints, old pies	Convex
Ventura–Simi	VS4-1	Annual grassland	16	203	2,864	Silty loam	270	6.9	8.0	2	85	3	Cow prints, grazing	Linear
Ventura–Simi	VS5-1	Annual grassland	17	183	2,902	Silty loam	250	7.5	7.3	2	80	5	Cow prints, animal holes	Convex
Ventura–Simi	VS6-1	Annual grassland	15	153	2,883	Silty loam	290	7.3	5.9	2	80	3	Cow prints, animal holes	Convex
Elizabeth Lake	PREL-2	Annual grassland	2	185	3,346	Sandy loam	300	5.4	2.1	12	85	1	Animal digs, previously burned	Linear

amsl = above mean sea level; psi = pounds per square inch; TBD = to be determined.

Table 6
Number of Habitat Indicators for San Fernando Valley Spineflower

			Slope (degrees)			Aspect (degrees)			Elevation (feet amsl)			Silt (%)			pH			Organic Matter (%)			Ammonium (ppm)			Soluble Potassium (meq/L)			Calcium (meq/L)			Manganese			Native Annual Forb Richness			
			Range	*Mean*	*SD*	*Range*	*Mean*	*SD*	*Range*	*Mean*	*SD*	*Range*	*Mean*	*SD*	*Range*	*Mean*	*SD*	*Range*	*Mean*	*SD*	*Range*	*Mean*	*SD*	*Range*	*Mean*	*SD*	*Range*	*Mean*	*SD*	*Range*	*Mean*	*SD*	*Range*	*Mean*	*SD*	
Values from Occupied Spineflower Sites (n=51)			*1–32*	*16.3*	*7.7*	*24–258*	*234*	*48*	*1,007–1,462*	*1,146*	*97.1*	*21–75.6*	*42.2*	*12.2*	*5.6–7.3*	*6.36*	*0.36*	*0.45–3.09*	*1.2*	*0.60*	*2.0–13.4*	*5.1*	*2.2*	*0.06–1.76*	*0.49*	*0.39*	*1.45–10.9*	*4.26*	*2.18*	*2.1–16.7*	*6.97*	*3.5*	*2–12*	*4.88*	*2.5*	
Intro Site	*Site ID*	*Year*[a]	*Value*	*In Range?*	*Score*	*Value*	*In Range?*	*Score*	*Value*	*In Range?*[b]	*Score*	*Value*	*In Range?*	*Score*	*Value*	*In Range?*	*Score*	*Value*	*In Range?*	*Score*	*Value*	*In Range?*	*Score*	*Value*	*In Range?*	*Score*	*Value*	*In Range?*	*Score*	*Value*	*In Range?*	*Score*	*Value*	*Meets Minimum?*[c]	*Score*	**Total Score**
Castaic Mesa	CM2-1	2017	3	Y	1	178	Y	1	1,407	Y	1	30%	Y	1	6.3	Y	1	2.3	Y	1	3.1	Y	1	0.08	Y	1	2.0	Y	1	2.8	Y	1	7	Y	1	11
Potrero	1A2	2016	11	Y	1	143	Y	1	1,023	Y	1	66%	Y	1	6.2	Y	1	3.9	N	0	2.8	Y	1	0.50	Y	1	3.1	Y	1	2.7	Y	1	2	Y	1	10
Potrero	1C1	2016	17	Y	1	118	Y	1	1,049	Y	1	59%	Y	1	6.5	Y	1	3.1	Y	1	2.8	Y	1	0.45	Y	1	9.6	Y	1	2.2	Y	1	1	N	0	10
San Martinez Grande	2F2	2016	13	Y	1	148	Y	1	1,434	Y	1	69%	Y	1	7.0	Y	1	2.8	Y	1	2.0	Y	1	0.14	Y	1	2.9	Y	1	0.8	N	0	2	Y	1	10
Ventura North of 126	3G2	2016	10	Y	1	203	Y	1	1,374	Y	1	68%	Y	1	6.4	Y	1	2.8	Y	1	2.6	Y	1	0.30	Y	1	2.1	Y	1	0.8	N	0	5	Y	1	10
Ventura North of 126	3I2	2016	13	Y	1	158	Y	1	1,133	Y	1	69%	Y	1	6.5	Y	1	4.5	N	0	3.3	Y	1	0.20	Y	1	2.0	Y	1	2.5	Y	1	3	Y	1	10
Potrero	1P1	2016	6	Y	1	150	Y	1	1,008	Y	1	74%	Y	1	6.4	Y	1	1.8	Y	1	3.5	Y	1	0.73	Y	1	5.2	Y	1	2.9	Y	1	1	N	0	10
San Martinez Grande	2S1	2016	11	Y	1	190	Y	1	1,117	Y	1	75%	Y	1	6.1	Y	1	1.5	Y	1	3.5	Y	1	0.20	Y	1	4.6	Y	1	3.0	Y	1	0	N	0	10
San Martinez Grande	2T2	2016	12	Y	1	135	Y	1	1,181	Y	1	73%	Y	1	6.4	Y	1	1.9	Y	1	3.1	Y	1	0.73	Y	1	3.5	Y	1	4.0	Y	1	1	N	0	10
Castaic Mesa	CM1-1	2017	12	Y	1	193	Y	1	1,409	Y	1	31%	Y	1	6.5	Y	1	2.4	Y	1	2.6	Y	1	0.06	Y	1	4.4	Y	1	2.0	N	0	9	Y	1	10
Castaic Mesa	CM3-1	2017	2	Y	1	173	Y	1	1,361	Y	1	38%	Y	1	6.1	Y	1	1.9	Y	1	1.9	N	0	0.14	Y	1	1.6	Y	1	3.8	Y	1	10	Y	1	10
Castaic Mesa	CM7-2	2017	8	Y	1	173	Y	1	1,338	Y	1	39%	Y	1	5.7	Y	1	2.1	Y	1	2.7	Y	1	0.14	Y	1	0.9	N	0	7.0	Y	1	11	Y	1	10
Castaic Mesa	CM8-1	2017	2	Y	1	198	Y	1	1,288	Y	1	31%	Y	1	6.2	Y	1	1.5	Y	1	1.3	N	0	0.19	Y	1	1.7	Y	1	2.5	Y	1	10	Y	1	10
Ventura North of 126	3U1	2016	18	Y	1	140	Y	1	1,706	Y[b]	0.5	81%	N	0	6.3	Y	1	2.7	Y	1	7.3	Y	1	0.18	Y	1	2.2	Y	1	3.7	Y	1	4	Y	1	9.5
Elizabeth Lake	PREL-2	2017	2	Y	1	173	Y	1	3,337	Y[2]	0.5	44%	Y	1	5.4	N	0	2.1	Y	1	2.6	Y	1	0.56	Y	1	3.0	Y	1	12.3	Y	1	6	Y	1	9.5
Ventura – Simi	VS2-1	2017	6	Y	1	183	Y	1	2,628	Y[b]	0.5	62%	Y	1	5.8	Y	1	5.7	N	0	3.9	Y	1	0.92	Y	1	3.4	Y	1	2.6	Y	1	4	Y	1	9.5
Ventura – Simi	VS6-2	2017	14	Y	1	203	Y	1	2,920	Y[b]	0.5	65%	Y	1	6.3	Y	1	6.9	N	0	5.2	Y	1	0.10	Y	1	3.7	Y	1	3.5	Y	1	4	Y	1	9.5
Ventura – Simi	VS6-3	2017	11	Y	1	213	Y	1	3,016	Y[b]	0.5	67%	Y	1	6.3	Y	1	6.7	N	0	4.4	Y	1	0.33	Y	1	2.5	Y	1	2.8	Y	1	7	Y	1	9.5
Ventura – Simi	VS6-4	2017	11	Y	1	173	Y	1	3,000	Y[b]	0.5	63%	Y	1	6.9	Y	1	9.5	N	0	3.0	Y	1	0.20	Y	1	4.2	Y	1	2.9	Y	1	5	Y	1	9.5
San Martinez Grande	2F1	2016	14	Y	1	133	Y	1	1,368	Y	1	76%	Y	1	6.9	Y	1	3.6	N	0	3.2	Y	1	0.27	Y	1	3.3	Y	1	1.1	N	0	4	Y	1	9
Ventura North of 126	3I1	2016	12	Y	1	178	Y	1	1,202	Y	1	61%	Y	1	6.5	Y	1	4.0	N	0	2.2	Y	1	0.24	Y	1	2.3	Y	1	1.4	N	0	4	Y	1	9
Potrero	1R1	2016	13	Y	1	185	Y	1	1,020	Y	1	79%	N	0	6.0	Y	1	2.4	Y	1	4.9	Y	1	0.45	Y	1	3.3	Y	1	8.3	Y	1	1	N	0	9
San Martinez Grande	2S2	2016	15	Y	1	135	Y	1	1,075	Y	1	69%	Y	1	6.9	Y	1	1.8	Y	1	3.4	Y	1	0.51	Y	1	6.4	Y	1	1.1	N	0	0	N	0	9
San Martinez Grande	2S3	2016	22	Y	1	160	Y	1	974	Y	1	75%	Y	1	7.0	Y	1	1.9	Y	1	4.1	Y	1	0.19	Y	1	3.6	Y	1	0.8	N	0	1	N	0	9
Castaic Mesa	CM2-2	2017	2	Y	1	183	Y	1	1,397	Y	1	46%	Y	1	6.2	Y	1	1.8	Y	1	1.2	N	0	0.26	Y	1	0.9	N	0	3.8	Y	1	9	Y	1	9

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Table 6
Number of Habitat Indicators for San Fernando Valley Spineflower

			Slope (degrees)			Aspect (degrees)			Elevation (feet amsl)			Silt (%)			pH			Organic Matter (%)			Ammonium (ppm)			Soluble Potassium (meq/L)			Calcium (meq/L)			Manganese			Native Annual Forb Richness			
			Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	
Values from Occupied Spineflower Sites (n=51)			1–32	16.3	7.7	24–258	234	48	1,007–1,462	1,146	97.1	21–75.6	42.2	12.2	5.6–7.3	6.36	0.36	0.45–3.09	1.2	0.60	2.0–13.4	5.1	2.2	0.06–1.76	0.49	0.39	1.45–10.9	4.26	2.18	2.1–16.7	6.97	3.5	2–12	4.88	2.5	
Intro Site	Site ID	Year[a]	Value	In Range?	Score	Value	In Range?	Score	Value	In Range?[b]	Score	Value	In Range?	Score	Value	In Range?	Score	Value	In Range?	Score	Value	In Range?	Score	Value	In Range?	Score	Value	In Range?	Score	Value	In Range?	Score	Value	Meets Minimum?[c]	Score	Total Score
Castaic Mesa	CM7-1	2017	3	Y	1	183	Y	1	1,358	Y	1	32%	Y	1	6.2	Y	1	2.4	Y	1	1.8	N	0	0.06	Y	1	0.9	N	0	4.9	Y	1	7	Y	1	9
Castaic Mesa	CM8-2	2017	12	Y	1	173	Y	1	1,273	Y	1	32%	Y	1	6.7	Y	1	1.7	Y	1	1.3	N	0	0.06	Y	1	1.1	N	0	2.1	Y	1	10	Y	1	9
Castaic Mesa	CM9-1	2017	5	Y	1	113	Y	1	1,239	Y	1	35%	Y	1	6.2	Y	1	1.9	Y	1	1.2	N	0	0.33	Y	1	0.8	N	0	4.6	Y	1	13	Y	1	9
Castaic Mesa	CM10-1	2017	1	Y	1	183	Y	1	1,215	Y	1	40%	Y	1	6.2	Y	1	2.0	Y	1	1.3	N	0	0.22	Y	1	1.2	N	0	3.8	Y	1	13	Y	1	9
Castaic Mesa	CM10-2	2017	11	Y	1	183	Y	1	1,273	Y	1	34%	Y	1	6.4	Y	1	2.2	Y	1	1.4	N	0	0.07	Y	1	3.3	Y	1	1.7	N	0	9	Y	1	9
Ventura – Simi	VS1-1	2017	9	Y	1	153	Y	1	2,609	Y[b]	0.5	59%	Y	1	6.1	Y	1	4.6	N	0	5.2	Y	1	2.10	N	0	3.7	Y	1	4.9	Y	1	2	Y	1	8.5
Ventura – Simi	VS3-1	2017	12	Y	1	188	Y	1	2,731	Y[b]	0.5	65%	Y	1	7.3	Y	1	5.0	N	0	3.4	Y	1	0.16	Y	1	4.8	Y	1	0.9	N	0	4	Y	1	8.5
Ventura – Simi	VS3-2	2017	20	Y	1	218	Y	1	2,779	Y[b]	0.5	55%	Y	1	6.3	Y	1	6.2	N	0	3.8	Y	1	0.19	Y	1	3.1	Y	1	1.5	N	0	3	Y	1	8.5
Ventura – Simi	VS4-1	2017	16	Y	1	203	Y	1	2,864	Y[b]	0.5	62%	Y	1	6.9	Y	1	8.0	N	0	2.7	Y	1	0.12	Y	1	3.7	Y	1	1.4	N	0	2	Y	1	8.5
Ventura – Simi	VS5-1	2017	17	Y	1	183	Y	1	2,902	Y[b]	0.5	55%	Y	1	7.5	N	0	7.3	N	0	2.4	Y	1	0.40	Y	1	6.2	Y	1	2.8	Y	1	2	Y	1	8.5
Ventura – Simi	VS6-1	2017	15	Y	1	153	Y	1	2,883	Y[b]	0.5	54%	Y	1	7.3	Y	1	5.9	N	0	2.5	Y	1	0.09	Y	1	5.7	Y	1	0.9	N	0	2	Y	1	8.5
Potrero	1A3	2016	6	Y	1	153	Y	1	1,051	Y	1	52%	Y	1	5.9	Y	1	3.3	N	0	1.8	N	0	0.81	Y	1	3.5	Y	1	3.2	Y	1	1	N	0	8
Ventura North of 126	3G1	2016	8	Y	1	178	Y	1	1,431	Y	1	83%	N	0	6.4	Y	1	4.1	N	0	2.9	Y	1	0.33	Y	1	3.0	Y	1	2.7	Y	1	0	N	0	8
Ventura North of 126	3J1	2016	22	Y	1	143	Y	1	1,274	Y	1	88%	N	0	7.2	Y	1	5.0	N	0	2.4	Y	1	0.46	Y	1	6.4	Y	1	0.7	N	0	2	Y	1	8
Ventura North of 126	3O1	2016	26	Y	1	145	Y	1	1,242	Y	1	74%	Y	1	6.5	Y	1	3.2	N	0	3.4	Y	1	1.63	Y	1	26.3	N	0	2.4	Y	1	1	N	0	8
Potrero	1P2	2016	15	Y	1	140	Y	1	1,004	Y	1	81%	N	0	6.9	Y	1	2.1	Y	1	3.1	Y	1	0.45	Y	1	5.7	Y	1	1.6	N	0	0	N	0	8
Potrero	1Q1	2016	24	Y	1	210	Y	1	1,054	Y	1	82%	N	0	7.1	Y	1	1.4	Y	1	2.8	Y	1	0.38	Y	1	4.9	Y	1	0.9	N	0	0	N	0	8
San Martinez Grande	2T1	2016	24	Y	1	135	Y	1	1,235	Y	1	77%	N	0	6.9	Y	1	2.2	Y	1	4.5	Y	1	0.53	Y	1	3.1	Y	1	1.3	N	0	0	N	0	8
Castaic Mesa	CM6-1	2017	1	Y	1	163	Y	1	1,134	Y	1	17%	N	0	6.7	Y	1	1.2	Y	1	1.2	N	0	0.10	Y	1	1.4	N	0	2.2	Y	1	5	Y	1	8
Potrero	1A1	2016	14	Y	1	153	Y	1	1,055	Y	1	86%	N	0	7.1	Y	1	4.5	N	0	3.2	Y	1	0.21	Y	1	6.7	Y	1	0.6	N	0	0	N	0	7
Potrero	1B1	2016	21	Y	1	153	Y	1	1,048	Y	1	84%	N	0	6.8	Y	1	4.1	N	0	2.4	Y	1	0.26	Y	1	7.2	Y	1	1.0	N	0	0	N	0	7
Potrero	1B2	2016	21	Y	1	173	Y	1	1,043	Y	1	90%	N	0	7.2	Y	1	4.4	N	0	3.3	Y	1	0.31	Y	1	6.7	Y	1	0.8	N	0	0	N	0	7
Potrero	1D1	2016	25	Y	1	148	Y	1	955	Y	1	85%	N	0	7.3	Y	1	4.2	N	0	2.4	Y	1	0.26	Y	1	7.4	Y	1	0.8	N	0	0	N	0	7
Ventura North of 126	3H1	2016	20	Y	1	143	Y	1	989	Y	1	89%	N	0	7.3	Y	1	3.7	N	0	1.7	N	0	0.42	Y	1	6.3	Y	1	0.9	N	0	2	Y	1	7
Ventura North of 126	3H2	2016	19	Y	1	173	Y	1	1,033	Y	1	87%	N	0	7.5	N	0	3.4	N	0	3.8	Y	1	0.23	Y	1	6.9	Y	1	1.1	N	0	2	Y	1	7
Ventura North of 126	3J2	2016	22	Y	1	178	Y	1	1,202	Y	1	82%	N	0	7.3	Y	1	5.6	N	0	3.4	Y	1	0.35	Y	1	7.0	Y	1	0.8	N	0	1	N	0	7

Table 6
Number of Habitat Indicators for San Fernando Valley Spineflower

			Slope (degrees)			Aspect (degrees)			Elevation (feet amsl)			Silt (%)			pH			Organic Matter (%)		
			Range	*Mean*	*SD*	*Range*	*Mean*	*SD*	*Range*	*Mean*	*SD*	*Range*	*Mean*	*SD*	*Range*	*Mean*	*SD*	*Range*	*Mean*	*SD*
Values from Occupied Spineflower Sites (n=51)			*1–32*	*16.3*	*7.7*	*24–258*	*234*	*48*	*1,007–1,462*	*1,146*	*97.1*	*21–75.6*	*42.2*	*12.2*	*5.6–7.3*	*6.36*	*0.36*	*0.45–3.09*	*1.2*	*0.60*
Intro Site	*Site ID*	*Year*[a]	*Value*	*In Range?*	*Score*	*Value*	*In Range?*	*Score*	*Value*	*In Range?*[b]	*Score*	*Value*	*In Range?*	*Score*	*Value*	*In Range?*	*Score*	*Value*	*In Range?*	*Score*
Castaic Mesa	CM5-1	2017	1	Y	1	163	Y	1	1,137	Y	1	11%	N	0	6.5	Y	1	0.6	Y	1
Potrero	1D2	2016	15	Y	1	163	Y	1	1,013	Y	1	82%	N	0	7.7	N	0	3.4	N	0

			Ammonium (ppm)			Soluble Potassium (meq/L)			Calcium (meq/L)			Manganese			Native Annual Forb Richness			
			Range	*Mean*	*SD*	*Range*	*Mean*	*SD*	*Range*	*Mean*	*SD*	*Range*	*Mean*	*SD*	*Range*	*Mean*	*SD*	
Values from Occupied Spineflower Sites (n=51)			*2.0–13.4*	*5.1*	*2.2*	*0.06–1.76*	*0.49*	*0.39*	*1.45–10.9*	*4.26*	*2.18*	*2.1–16.7*	*6.97*	*3.5*	*2–12*	*4.88*	*2.5*	
Intro Site	*Site ID*	*Year*[a]	*Value*	*In Range?*	*Score*	*Value*	*In Range?*	*Score*	*Value*	*In Range?*	*Score*	*Value*	*In Range?*	*Score*	*Value*	*Meets Minimum?*[c]	*Score*	**Total Score**
Castaic Mesa	CM5-1	2017	0.9	N	0	0.07	Y	1	0.8	N	0	1.6	N	0	6	Y	1	7
Potrero	1D2	2016	1.9	N	0	0.38	Y	1	6.9	Y	1	0.4	N	0	0	N	0	5

amsl = above mean sea level; ppm = parts per million; meq/L = milliequivalents of solute per liter; SD = standard deviation.
Shaded cells indicate mean values that are within range or that meet minimum requirements.
[a] year = year evaluated
[b] Plots within the elevation range of extant populations of spineflower (930–1,469 feet amsl) received a score of 1, while those outside of this range but within historic elevation range (i.e., including extirpated sites) of 0 - 4,139 ft amsl, were assigned a score of 0.5.
[c] Plots were assigned a score of 1 if they had at least the minimum number of native annual forbs observed in the reference sites.

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4 IMPLEMENTATION PLAN

Implementation of the Introduction Plan began in fall 2016 with site investigations and analysis, and initiation of seeding trials at the Potrero Preserve Expansion and the San Martinez Grande Preserve Expansion – Los Angeles County that are expected to continue through summer of 2018. More widespread spineflower introductions are planned for these two introduction sites pending results of the 2-year seeding trials. Additional seeding trials and spineflower introductions are planned for the other introduction sites identified in this Introduction Plan as outlined in this section.

Implementation of the Introduction Plan will be accomplished by an experienced, qualified native Landscape Contractor and administered and monitored by the Project Biologist and Biological Monitor. All stages of the Implementation Plan, from site preparation to seeding, will be overseen by the Project Biologist, who will ensure that the Introduction Plan is appropriately executed.

4.1 Phased Introduction Approach

Spineflower introduction within the Additional Conservation Areas will occur in phases. The projected phasing is provided in Table 7. The phasing provides an initial sequence for planning purposes, but selected locations in the phasing sequence may be modified as appropriate based on early results of introduction attempts. A phased approach to the Introduction Plan was selected for the following reasons:

1. Spineflower seed application over 10 acres of habitat will require a large amount of seed. A phased approach will provide lead time to conduct seed bulking and wild seed collections needed to acquire the necessary seed resources to implement spineflower introduction in the various areas.
2. A phased approach will allow opportunities to learn from experiences introducing spineflower. Lessons learned in earlier phases will support decision making in later phases to improve application and management methods for introduction of the species.
3. A phased approach will spread the spineflower introductions out over several years. Variable inter-annual weather conditions are expected, some of which may be better for spineflower establishment. Therefore, a phased approach will allow for spineflower introductions during varying weather conditions, which may affect success.

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Table 7
Phase Implementation Schedule

Phase	Introduction Areas	Implementation Sequence
1	Potrero Preserve Expansion San Martinez Grande Preserve Expansion – Los Angeles	Implementation began in 2016 with initiation of seeding trials at both locations.
2	San Martinez Grande Preserve Expansion – Ventura County Castaic Mesa	Site investigations completed in 2017. Implementation will continue with seeding trials beginning in 2018.
3	Ventura County – Facing Simi Valley Elizabeth Lake	Site investigations completed in 2017. Implementation will continue with seeding trials beginning in 2020.

4.2 Preliminary Schedule for Implementation

The implementation schedule provided herein includes a sequential schedule of procedural steps to be implemented during the program at each introduction site. The first step for each introduction site is the establishment of seeding trials. A series of initial seeding trials will be implemented at the proposed introduction areas prior to widespread introductions. The seeding trials are expected to take a minimum of 2 years to implement and obtain meaningful results. The seeding trials will be followed by more widespread spineflower introductions if the seeding trials demonstrate suitable habitat for spineflower. The locations for widespread introductions will be based on where seeding trials demonstrate a reasonable probability of success, as determined by the Project Biologist in coordination with Newhall Land and the Spineflower Adaptive Management Working Group, but will occur on a minimum of 10 acres within the Additional Conservation Areas regardless of the outcomes of the seeding trials.

A general schedule of site preparation, seeding trials, topsoil salvaging, and seeding activities is included in Table 8 to outline the sequential process for spineflower introductions. Regardless of the implementation phase, each introduction area will follow the same implementation process. (Note: the information in the "Year" column in Table 8 is relative to the start date for each implementation phase as defined in Table 7. For instance, Year 1 of Phase 1 is 2016; Year 1 of Phase 2 is 2018.)

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Table 8
Task Implementation Schedule

Year	Task	Seasonality	Stage of Program
Ongoing	Procure seed through wild collections and seed bulking at a nursery	November–June	Ongoing as needed to provide adequate seed in advance of planned seeding events
1–2	Implement Seeding Trials	Apply seed in fall or early winter	Start in fall and continue through two growing seasons
1–10	Conduct biological monitoring	Monthly during the growing season in Year 1 (November–June); four times per year thereafter	In Years 1 and 2, monitoring of seeding trials; Years 3–10, monitoring of introduction sites
2	Determine relative suitability of introduction area based on results of seeding trials and confer with Spineflower Adaptive Management Working Group about whether to proceed with widespread introductions	Summer of second year	After second year results are known, but early enough to plan for spineflower introductions in the fall
2	Conduct pre-disturbance survey	Spring or summer	Complete surveys in the appropriate season prior to spineflower introduction if land disturbance is planned
2	Prepare introduction site (fencing, weed control, thatch removal, scraping/compaction, etc.)	Summer or fall (July–October)	Complete site preparation prior to fall of spineflower introduction
2	Salvage and transfer topsoil (if applicable)	Summer or Fall (July–October)	Complete site preparation prior to fall of spineflower introduction
3	Apply spineflower seed (collected and bulked seed)	Fall or early winter (November–December)	Start prior to onset of rainy season at beginning of third year
3	Map spineflower introduction areas	Fall or Winter after seeding	At the beginning of the spineflower introduction stage
3–4	Implement supplemental watering	During the growing season only if natural rainfall is lacking for a period of greater than approximately 3 weeks	Only as needed during the first and second year after spineflower introduction
3–10	Perform maintenance and weed control	Monthly during the growing season (November–June), and as needed during the dry season (July–October)	Maintenance will continue through duration of 10-year period
4–5	Perform habitat enhancement in buffer areas	Fall or early winter	1–2 years after spineflower introduction
4–5	Apply native seed mix in spineflower introduction areas	Fall or early winter	1–2 years after spineflower introduction

Table 8
Task Implementation Schedule

Year	Task	Seasonality	Stage of Program
8–10	Evaluate data collected in Years 3–7 to examine the relationship of spineflower productivity, and whether separate standards should be applied to introduction sites in new ecoregions: account for differences in climate, elevation, and other variables that could affect spineflower productivity.	Winter	Evaluation at completion of the fifth year of conducting biological monitoring of introduction sites

4.3 Seed Procurement

The seed application rate used for the initial seeding trials was 0.23 grams per 2.25 square meters (1.5-meter by 1.5-meter plots, including the 0.5-meter buffers), which resulted in a low density of spineflower germinants. Therefore, the target application rate will be doubled to approximately 0.46 grams per 2.25 square meters, or approximately 1.8 pounds per acre. As a point of reference, approximately 347 grams (or 0.76 pounds) of seed was collected from wild occurrences per the SCP conservation requirement in 2014, which was approximately 5% of the seed produced in that year within the spineflower preserves. Approximately 10 acres are planned for spineflower seeding, which would require approximately 18 pounds of spineflower seed. Therefore, wild seed collections alone will not be adequate to support the Introduction Plan and seed bulking will be a necessary aspect of this plan to ensure there is adequate seed for dispersal.

Seed bulking will be conducted in a manner that retains natural genetic diversity of produced seed to the extent feasible. Seed collection will be conducted in a manner that captures the existing genetic diversity of the population without harming the plant populations' long term viability. The collection of source seed will be conducted as a maternal line sampled collection where seeds from each individual sampled in the occurrence location are kept separate (RSABG 2017). The maternal line collection will include seed collected from 50 plants randomly sampled from each occurrence location (e.g., 50 separate plants from the SCP San Martinez Grande Spineflower Preserve, 50 separate plants from the SCP Potrero Spineflower Preserve, etc.). Seed collections will include the various SCP preserve and non-preserve sites within the Santa Clarita population, as well as the Ahmanson Ranch population (to the extent it is authorized and feasible). The seeds collected will be used to grow out and produce seed for use in this introduction program.

Seed bulking with maternal line collections will enable the researcher to control and therefore maximize the number of parental individuals contributing to the regenerated seed collection (RSABG 2017). It is typical for some individuals within a population to produce more seeds than others; therefore it is important to not bias a "bulk seed" collection in favor of these unusually productive individuals (RSABG 2017). Where it is deemed necessary to take advantage of the seed production from these fecund individuals, those samples will be kept separate from the rest of the collections. Seed bulking may be conducted over multiple seasons, depending on how productive a single bulking session is, to procure the amount of spineflower seed necessary to implement this Introduction Plan. Seed bulking over multiple seasons will also ensure that natural genetic diversity is retained in the seed collections.

4.4 Seeding Trials

Seeding trials will be implemented within Additional Conservation Areas prior to broad-scale attempts at introduction to evaluate spineflower performance. The selection of specific locations for seeding trials is based in part on the prioritization matrix included in this Introduction Plan, which scores sites based on how well they meet the defined parameters from the Habitat Characterization Study (Appendix A). Future seeding trials will be modeled after the initial seeding trials that were initiated in 2016 and are described in the San Fernando Valley Spineflower Habitat Manipulation and Seeding Experiment (Appendix B). The seeding methods and plot treatments may be modified as more is learned from successive seeding trials and additional management questions are raised. The test plots will be monitored for a minimum of 2 years after seeding to determine seedling survival/density, phenology, and species reproductive success for the various treatments. A summary of the seeding trials will be prepared annually while the trials are ongoing, with results compiled and analyzed for review by the Technical Advisory Group.

4.5 Pre-Introduction Determination

Upon completion of the second growing season for the seeding trials for each Additional Conservation Area, the Project Biologist will coordinate with the Spineflower Adaptive Management Working Group to evaluate relative suitability of introduction sites based on results of seeding trials. The main purpose will be to determine whether to proceed with widespread introductions at the Additional Conservation Area, and if so, to determine the preferred methods and locations. If an Additional Conservation Area is determined not to be suitable, a plan will be developed for reallocating resources to a more favorable Additional Conservation Area in coordination with the Spineflower Adaptive Management Working Group. The overall goal of establishing two self-sustaining, persistent spineflower populations in currently unoccupied areas, and the commitment to performing at least 10 acres of spineflower introduction across the Additional Conservation Areas, will remain unchanged.

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4.6 Existing Resource Impact Avoidance

Currently, no special-status species or resources are known within the areas identified for introduction. However, the introduction sites may be near protected resources, or resources requiring protection may be discovered. The Project Biologist or the assigned Biological Monitor will conduct a survey prior to implementation of land-disturbing actions (e.g., topsoil excavation, topsoil spreading, raking) associated with the Introduction Plan to evaluate potential for special-status species and/or their habitat. Any resources to be protected will be adequately staked and/or flagged for visual identification, or relocated from the site, prior to the start of the spineflower introduction activities. Staking will clearly demarcate each treatment area by assigned colored flagging.

Should any questions or concerns arise relating to the resources to be protected, or if additional unanticipated environmental impacts to the sites or surrounding vegetation communities result during project implementation, the Project Biologist (or other appropriate party) will consult with CDFW and/or USFWS, as appropriate, for direction regarding additional avoidance measures and/or remedial measures that may be implemented to address these additional impacts.

4.7 Site Access, Fencing, and Signage

All spineflower introduction sites will be closed to public access. Existing dirt access roads and utility easement access roads within the Additional Conservation Areas will function as the intended access points to the introduction sites for the Project Biologist, Landscape Contractor, utility personnel, and emergency services vehicles (e.g., police, fire, and medical). The entry into each spineflower introduction site from the dirt access roads will be gated and locked at the outside edges of the spineflower introduction site where feasible.

Signs identifying restricted land and discouraging unauthorized access/entry into the spineflower introduction sites will be posted on all gates providing access to introduction sites, adjacent to any roads that border introduction sites, and along any spineflower introduction site fencing at approximately 800-foot intervals. Signs will be constructed of outdoor all-weather material and will be 12 by 16 inches in size. Gate signs will be reflective for night visibility.

The signs will indicate that enhancement activities are in progress and that the areas are to be protected. A contact number will be included. The final verbiage for the signs will be coordinated with and approved by the Project Biologist, Newhall Land, CDFW, and USFWS. The only persons or entities allowed to access the introduction sites will be the Project Biologist, Landscape Contractor, Newhall Land or its designee, CDFW, USFWS, and Land Veritas staff or their designee (for Elizabeth Lake sites only).

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4.8 Site Preparation

Timing of the site preparation, soil salvaging and placement, and seed application work will be determined based on seasonal weather constraints. If soil salvage and placement work is planned, it should occur prior to the onset of the rainy season, before seed germination occurs. To take advantage of potential seasonal rains during the growing season, seed application should occur early in the rainy season (i.e., November or December).

Site preparation will begin in the fall and will include delineating the limits of the introduction sites, initiating weed control activities, and excavating soil from the soil deposition areas (if applicable). Site preparation activities are detailed below:

A. Work areas will be delineated and marked clearly in the field prior to initiation of any site work. Temporary construction fencing (e.g., orange plastic fencing) will be installed around the perimeter of the proposed introduction sites. Any native shrubs or areas that should be avoided during site preparation work will be flagged with brightly colored flagging tape. Employees will limit their activities and vehicles to the proposed project areas and routes of travel.

B. Weed control activities will be initiated prior to seed application and will include removing non-native vegetative debris from the introduction area. Non-native vegetation will be raked up and removed from the soil surface. All non-native vegetation removed during this process will be hauled away from the site and disposed of properly. Following weeding and thatch removal, the sites will undergo series of weed reduction cycles. During the weed reduction cycles, the weeds will be allowed to germinate following initial rain events that promote weed seed germination at the onset of the rainy season in the fall or early winter. Approximately 2–4 weeks following weed seed germination, all the germinated weeds will be controlled with herbicide. The weeds will be controlled when they are small enough that no physical removal is necessary that would otherwise disturb the soil and promote additional weed germination.

C. Areas where salvaged topsoil will be placed are not subject to the weed control activities described above. Topsoil deposition areas will be prepared by excavating existing soil down to a depth of approximately 8–10 inches. The concept is to ensure that the salvaged soil placed at the introduction site is relatively contained after it is placed to avoid excessive soil sloughing and erosion, particularly around the edges of the plots. Soil excavation may not be necessary or possible at sites that are inaccessible for heavy equipment. At these locations, the Landscape Contractor will taper the edges of the soil receptor areas to eliminate abrupt grade changes.

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4.9 Soil Preparation

If the results of the seeding trials show that soil compaction or soil scraping is beneficial to spineflower performance, the introduction areas will be compacted or scraped prior to seed application (preliminary results of the initial seeding trials suggest that soil compaction may actually be counterproductive, but more information is needed). Soil compaction will be accomplished using a hand tamper or pneumatic tamper to achieve compaction levels at approximately 300 pounds per square inch (psi) or other appropriate compaction level, as determined by the seeding trials (see Appendix B). Soil scraping may be used to remove the surface layer (top approximately 2–3 inches) to remove the weed seed bank and expose nutrient poor soils to mimic conditions at the Airport Mesa and Commerce Center occurrences within the Santa Clarita location where spineflower grows on scraped dirt road beds. The Biological Monitor, under the direction of the Project Biologist, will carefully monitor compaction or scraping operations during the process to achieve the desired results.

4.10 Soil Salvaging and Placement

It is anticipated that there will be opportunities for topsoil salvage from spineflower occupied areas within the proposed developments on Newhall Land property in the Santa Clarita location. However, due to the rugged terrain of many of the selected introduction sites, transporting and depositing salvaged topsoil may be infeasible at some of the sites. The use of salvaged topsoil at introduction sites will be prioritized in areas where there is equipment access (e.g., Potrero, Castaic Mesa, Ventura–Simi). Transport and deposition by hand in 5-gallon buckets or wheelbarrows of small amounts of seedbank topsoil may be feasible for remote areas. The following general methods are proposed for salvaging and placement:

A. Topsoil will be salvaged from known locations supporting spineflower within the impact footprint of proposed Newhall Land development areas. Topsoil salvage will include a two-stage process where the seedbank topsoil (top 0.5 inches to 1 inch) will be harvested first and set aside. The subsoil below the seedbank topsoil will be harvested next at a depth of approximately 8–10 inches. The two soil types will be kept segregated until placement. The purpose of the two-stage topsoil salvage is to segregate the soils that are expected to contain the spineflower seedbank from the underlying soil so that the seedbank can be placed back on top of the underlying soil at the introduction site without diluting the seedbank in a deeper soil column. A combination of hand labor and heavy equipment may be used to salvage topsoil. The type of equipment used will depend on factors such as access to salvage areas, traction, and ability to transport and deposit the soil. The Landscape Contractor, in consultation with the Biological Monitor, will assess the effectiveness of the equipment and determine whether modifications (to either techniques or equipment) are necessary to improve soil salvaging success or prevent excessive disturbance.

B. Salvaged topsoil will be either transported directly to the targeted introduction sites or stored until it can be transferred later. The seedbank topsoil and underlying subsoil will be kept segregated during transport or storage. All stockpiled topsoil will be contained and covered during storage. Seedbank topsoil shall be stored in a secure location not subject to precipitation or underlying soil moisture (e.g., on pallets).

C. Once at the introduction site, the soil will be spread out to an approximate depth of 8–10 inches within the designated soil receptor plots. The underlying subsoil layer will be placed first. Following the placement of the lower subsoil layer, the seedbank soil layer will be spread over the surface at a depth of approximately 0.5 inches to 1 inch. Assistance from a field crew will be necessary to help spread the soil evenly. The finished grade of the soil placement areas will be relatively consistent across each area, and will match the surrounding slope and aspect as much as feasible. The edges of the soil plots will be contoured to match the surrounding grades.

4.11 Spineflower Seed Application

Seed application methods for spineflower will follow those determined to be the most successful based on the seeding trials. The application method may include hand-broadcast seeding, seedbank topsoil application (described in Section 4.9, Soil Preparation), drill seeding, or other method determined to be successful. As described earlier, specific seed sources for targeted seeding locations will rely on available information from the spineflower genetics study that is currently in progress (Rogers 2016) to ensure that the introduction program is consistent with the most current conservation principles of population genetics as well as the specific genetic characteristics of the spineflower populations.

A. After all site preparation measures have been completed as described above, including reducing non-native species cover to below a 10% threshold, the spineflower seed will be distributed on site within the designated introduction sites. The spineflower seed will be spread by hand evenly over the introduction sites at an application rate that is determined based on the results of the seeding trials.

B. For broadcast seeding, the seed will be lightly raked into the soil with landscaping rakes, with a target seed depth of approximately 0.25 to 0.5 inches. Similarly, if seed is applied with a seed drill, seed will be planted at a depth of 0.25 to 0.5 inches.

C. After seed application, the site will be delicately watered in to help settle the soil around the introduction site.

D. The boundaries of the seeded areas will be marked with a GPS unit after planting to facilitate relocating the plots for monitoring in subsequent years, to quantify the acreage of the site, and to produce a map of the planted plots.

4.12 Introduction Documentation

The GPS locations of the introduction areas will be overlaid on an aerial image of the site to document the introduction and create a site map. The site map will be used in annual status reports to illustrate the introduction areas and associated features. The site map will also serve as a permanent record that will be used for long-term biological monitoring, reporting, and management purposes. Introduction attempts will be documented in installation reports.

The installation reports will include the following:

1. A summary of the soil salvage and placement process and a detailed description of the site preparation and implementation procedures, including any significant variation from the general methods described in this Introduction Plan
2. Representative photographs of the soil salvage and placement procedure and from fixed photo points
3. A list of people involved in the work and their responsibilities
4. A description of any problems or unexpected occurrences during the process
5. A figure depicting the layout of the introduction area

4.13 Supplemental Watering

Supplemental watering may be conducted to facilitate the establishment of the newly planted spineflower seeds and to promote seed production in the first year. Ideally, the introduction sites will rely solely on rainfall after the initial watering-in period. However, periodic droughts are common in the region. In the first year, supplemental watering may be applied if natural rainfall is lacking for a period of greater than approximately 3 weeks. The determination of whether or not to provide supplemental watering in any given period will be made by the Project Biologist after consideration of average temperatures, day lengths, and natural rainfall amounts compared to average values for these weather factors for each site. If used, supplemental watering will only be conducted during the growing season (November through May). Supplemental watering is only anticipated during the first year. However, if drought conditions develop in the second year, particularly in the middle of the growing season after spineflower has germinated, adaptive management may necessitate supplemental watering in the second year. No supplemental watering will be supplied to the seeded introduction sites after the second year.

A. Soil receptor sites will be initially watered in to help settle the soil and to prevent the formation of gaps and air pockets. Ideally, the initial watering-in event will occur prior to the onset of rain, so that the soil can be effectively settled and somewhat stabilized before the first rain event. A follow-up site visit will be made 2–3 days after the initial watering-in period to spread additional native soil to fill in gaps or depressions that may form after the soil has settled. After the gaps and depressions have been filled, the area will be watered in a second time.

B. Supplemental watering will occur in a manner that does not cause sediment loss or soil erosion. Watering will be conducted with light, periodic applications of water that allow infiltration and do not create runoff.

4.14 Habitat Enhancement

Enhancement activities in areas surrounding introduction sites will be implemented prior to or concurrently with spineflower introduction. Habitat enhancement within spineflower introduction sites will be implemented following spineflower introduction. Anticipated enhancement activities will include passive and active revegetation of native vegetation communities. Enhancement activities will occur with an adaptive management approach that will continue beyond the 10-year maintenance and monitoring period and into the long-term management period. Targeted areas for habitat enhancement correspond with the sites identified for spineflower introduction and an approximately 50-foot area surrounding introduction sites. The areas identified for habitat enhancement surrounding introduction sites are subject to adjustment for topographical and other constraints, such as existing roads and trails, and for the severity of threats to spineflower populations posed by surrounding land uses and activities. The surrounding land uses of the proposed introduction areas are limited to agriculture, grazing, oil extraction, and transportation. The proposed introduction areas are not adjacent to developed areas; therefore, the threats to the introduction sites are largely related to historical site disturbances (e.g., cattle grazing and oil extraction) that resulted in a prevalence of non-native, invasive plant species. Argentine ants are not considered to be a significant long-term risk to spineflower at the introduction sites because they are all well separated from areas supporting potential source populations, such as urban development. The enhancement areas surrounding introduction sites are intended to help minimize invasion of non-native plant species, which could threaten the quality of the habitat for spineflower occupation.

4.15 Seed Mix for Habitat Enhancement

The enhancement effort will utilize only locally indigenous plant materials and seed appropriate to the habitat being enhanced. Plants and seed will originate from the local region at elevations similar to the enhancement area—i.e., no more than 20 miles from the site and no more than 300 feet in elevation difference. Seed will come from reputable sources, will be properly labeled, and will be tested prior to delivery to ensure it is free of problematic weeds, pests, and disease, including Argentine ants.

Native species planting efforts will focus on the application of native seed rather than container plants for habitat enhancement. Seed application will occur with two separate enhancement goals. One seed mix will include herbaceous species that commonly co-occur with spineflower and will be used in introduction sites to help establish the appropriate species composition (Table 9). Species included in Table 9 are positively correlated with occupied spineflower occurrences (Appendix A). The herbaceous seed mix will be applied in the second or third year after spineflower introduction, and will be applied in unoccupied areas. The second seed mix will contain the core coastal sage components for use in enhancement of buffer habitat surrounding introduction sites (Table 10). At least initially, shrubs will not be planted within introduction sites to avoid competition with spineflower during the establishment period. The coastal scrub seed mix will be applied in unoccupied areas to enhance habitat and develop a native species composition surrounding introduction sites.

The seed mixes provided below will be used on spineflower introduction sites in the vicinity of Potrero Preserve, San Martinez Grande Preserve, and Castaic Mesa. Additional native seed mixes will be developed for higher-elevation sites, including Ventura–Simi and Elizabeth Lake, after the test plot results have been completed and the suite of appropriate native species is known. The habitat enhancement effort will be accomplished from seeding in a non-irrigated condition. The seeding may be repeated annually as determined necessary based on the results of the previous year's germination and resultant native cover.

Table 9
Herbaceous Seed Mix

Botanical Name	Common Name	Minimum PLS (%)	Rate (lb/acre)
Acmispon strigosus	strigose bird's-foot trefoil	80	2
Chaenactis glabriuscula	yellow pincushion	10	2
Eschscholzia californica	California poppy	74	1
Lasthenia californica	California goldfields	30	2
Logfia filaginoides	California cottonrose	0.1	4
Lupinus bicolor	miniature lupine	78	5
Trichostema lanceolatum	vinegarweed	N/A	1
Pectocarya linearis ssp. *ferocula*	sagebrush combseed	N/A	1
		Total	**18**

PLS = a measure of pure live seed, which combines percent germination with seed purity; lb/acre = pounds per acre; N/A = information not available.

Table 10
Coastal Scrub Seed Mix

Botanical Name	Common Name	Minimum PLS (%)	Rate (lb/acre)
Artemisia californica	California sagebrush	7.5	2
Encelia californica	California brittlebush	24	4
Eriogonum fasciculatum var. *foliolosum*	California buckwheat	6.5	6
Ericameria palmeri	Palmer's goldenbush	4	2
Mirabilis laevis var. *crassifolia*	California four o'clock	56	3
Pseudognaphalium californicum	California everlasting	2.5	0.5
Salvia apiana	white sage	21	1
Salvia leucophylla	purple sage	53	2
Salvia mellifera	black sage	35	1
		Total	**21.5**

PLS = a measure of pure live seed, which combines percent germination with seed purity; lb/acre = pounds per acre; N/A = information not available.

4.16 Enhancement Seed Mix Application

Prior to seeding, enhancement areas will be adequately prepared, which will include exotic species and weed control/removal, thatch removal, soil scarification if deemed appropriate, and soil amending if deemed necessary based on soils analysis for overall fertility and suitability for native species growth. The Project Biologist will determine the need for soil amending based on the results of the laboratory analysis (Appendix H).

Once the site is prepared for seed application, the seed mix will be hand broadcast over the surface and lightly raked into the soil. Following application of seed, a seed-topper mulch (e.g., fine-particle mulch) will be applied to cover the site at a depth of approximately 0.5 inches to protect the seed from granivory by birds, rodents, ants, etc. and unwanted wind dispersal. The mulch will also aid in keeping moisture in the soils to aid seed germination.

Labels for each seed mixture will be inspected and approved by the Project Biologist prior to mixing and application. All seeded enhancement areas will be mapped with GPS for inclusion in project documentation and monitoring maps.

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5 MAINTENANCE PROGRAM

The maintenance program will be initiated upon implementation of the seeding trials for each introduction site. Maintenance will be necessary throughout the duration of the 10-year maintenance and monitoring period, but is expected to require the greatest level of effort in the first few seasons of growth to help offset the negative effects of the site disturbance and the exotic invasive plant competition that is expected at introduction sites. Subsequent seasons should require less intensive maintenance activities as the vegetation reaches a state of equilibrium, but persistent control of invasive weeds will likely be required.

The overall maintenance program directs enhancement efforts to focus on (1) reducing annual non-native/exotic plant species cover and competition to help facilitate spineflower establishment, persistence, and recruitment; (2) increasing native species cover and diversity in disturbed areas, particularly in areas surrounding introduction sites that function as a buffer; and (3) providing regulation and protection of the spineflower preserve boundaries from unauthorized human activity and intrusion.

Maintenance Activities

Due to the sensitivity of the species and potential for unanticipated disturbance, the Landscape Contractor will coordinate with the Project Biologist for scheduling and conducting maintenance activities during the growing season of spineflower. Maintenance should be conducted as recommended by the Project Biologist, but is anticipated monthly during the growing season (November–June) and bimonthly during the dry season (July–October). It is the intent of this Introduction Plan to intervene only as necessary to help ensure the conservation of spineflower habitat and associated habitat immediately surrounding introduction sites. Remedial measures will only be implemented if it is determined in consultation between the Project Biologist, Newhall Land, CDFW, and USFWS that there is a risk to the persistence of the spineflower or associated habitat on site.

Weed Control: Non-native/weed species present within the potential introduction sites consist largely of annual grasses and forbs including brome grasses (*Bromus madritensis, B. diandrus, B. tectorum*), filaree (*Erodium moschatum, E. cicutarium, E. botrys*), wild oat (*Avena barbata, A. fatua*), Russian thistle (*Salsola tragus, S. australis*), Mediterranean grass (*Schismus barbatus, S. arabicus*), and tocalote (*Centaurea melitensis*). Target non-native plant species selected for control in this Introduction Plan include those non-native plant species that are potentially invasive and/or pose a threat to the establishment, development, or persistence of spineflower and the habitat supporting it. The primary target species will be those species identified and rated as "High" and "Moderate" by the California Invasive Plant Council in the online California Invasive Plant

Inventory (Cal-IPC 2016). The weed species with these ratings have the greatest potential for negative ecological impact.

Other weed species may also be recommended for control if they are documented on site and pose a risk of invasion. Weed growth and prevalence will be assessed and documented by the Biological Monitor during regular monitoring visits, and recommendations for control will be made, as necessary, based on need and seasonal conditions.

Weed control measures will include hand removal, mechanical removal (e.g., cutting with weed whip machines/line trimmers, hoeing), and herbicide application. The selected method of weed control will be based on the most effective method for the species being targeted and the stage of plant development, as well as with the method that results in the least disturbance to spineflower plants. Weeding will be performed primarily during the growing season of spineflower as that is when most weeds will be actively growing and competing with native plants. Therefore, most weed control activities will need to be conducted in a manner that minimizes disturbance to spineflower. Weed control will likely consist of mechanical removal with line trimmers, which minimizes soil disturbance while minimizing the production of weed seeds. All debris and slash generated from the weed removal activities will be disposed of off site in a legally acceptable manner.

The SCP describes weed control methods used in an experimental setting at Ahmanson Ranch, whereby the researchers tested the efficacy of weed whipping and herbicide (Roundup) application on vegetation within spineflower plots. Results of the experiment showed that plots treated with herbicide application produced greater spineflower growth and reproductive output; however, rainfall continuing into late spring may have influenced the results by allowing for regrowth of vegetation within the weed-whipped plot (Dudek 2010). Although this experiment showed that herbicide-treated plots produced greater spineflower growth, the plots were seeded with spineflower after herbicide application. The introduction of post-herbicide seed confounded the study results and no conclusions regarding the potential direct impacts to naturally occurring spineflower can be made (Dudek 2010). Therefore, these results may not directly translate to methods suitable for natural recruitment of spineflower populations.

If herbicides are used, applications will either involve foliar applications to the entire plant or cutting the plant and painting the severed stem or trunk with a systemic herbicide. Cutting and painting the severed stems will likely be preferred because it reduces the chance of inadvertent overspray and consequent non-target-plant damage. The Landscape Contractor will coordinate with the Biological Monitor to identify specific locations within the site where herbicide treatments would be appropriate. All herbicide treatments must be applied under the direction of a person holding a valid Qualified Applicator License. The Landscape Contractor must also possess a Pest Control Business License. Non-selective herbicides that have activity on dicot plants will not be used in the spineflower planting areas during the growing period of spineflower. Any use of herbicides within the introduction sites will be consistent with the recommended use limitations identified in the U.S. Environmental Protection Agency's Office of Pesticide Programs, Endangered Species Protection Program County Bulletins (EPA n.d.).

Fencing: Fencing will be used at key locations to prevent encroachment on, or disturbance to, spineflower introduction sites. The Landscape Contractor will ensure that all fencing remains in place and effectively protects the introduction sites from disturbance.

Signage: Signs will be maintained and replaced as necessary by the Landscape Contractor.

Trash and Debris: All trash and debris will be removed by the Landscape Contractor from the introduction sites on a regular basis during maintenance visits.

Erosion Control: Any erosion or sediment control features installed on site will be maintained by the Landscape Contractor until they are no longer necessary, as determined by the Project Biologist. Erosion problems, if detected, will be repaired by the Landscape Contractor as soon after detection as possible. Measures will be taken by the Landscape Contractor to help prevent erosion within the introduction sites, as recommended by the Project Biologist.

Access Control: Signs will be installed to inform the public of the land closure, specify the purpose of the spineflower introduction sites, and provide a contact number to report emergencies or obtain additional information. The introduction sites will be monitored regularly during maintenance visits and checked for evidence of human disturbance, including off-road vehicle use, illegal dumping, vandalism, pedestrian access, and unauthorized brush clearing.

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6 MONITORING PROGRAM

Biological monitoring of the introduction sites will be conducted under the direction of the Project Biologist for the purpose of determining the status of the introduced spineflower through periodic monitoring and collection of qualitative and quantitative data. Monitoring will occur in the winter and spring of each year while the spineflower plants are actively growing and in bloom/seed. Additional monitoring at the sites will occur periodically throughout the year to determine the need for maintenance measures related to protecting the spineflower introduction sites from weed invasion or other disturbances.

6.1 Establishment of Reference Sites

Comparison of the spineflower introduction sites to reference sites is a critical component of the monitoring plan. Reference sites will be established within both the Santa Clarita population and the Ahmanson Ranch population to ensure that the reference sites encompass the range of conditions currently supporting spineflower. Reference sites within the Santa Clarita population will be selected from a subset of the sampling plots within the SCP spineflower preserves that were established for the Habitat Characterization Study (Appendix A). Comparable sampling plots (e.g., size and layout) will be established within reference sites at spineflower-occupied areas at Ahmanson Ranch. A sufficient number of sampling plots shall be established to capture site variability so that collectively the reference sites are representative of the range of conditions of occupied spineflower habitat. The selected reference sites are expected to remain undisturbed by adverse human activities through the duration of the monitoring program, because only locations with adequate access control or locations remote from human activities will be selected.

Spineflower population data from sampling plots will establish the baseline from which to measure the effects of the proposed enhancement and introduction program. Baselines will be based on multi-year data so that they represent natural variability over time. Some of these data already exist for the Santa Clarita population, but additional baseline data will be collected beginning in 2017. The baseline surveys will be focused on measuring plant densities (e.g., number of plants per unit area), seed productivity (e.g., seeds produced per plant), and seed viability (e.g., percentage of viable seed) within the reference sites. In addition to baseline data, reference data will be collected annually during the monitoring program to continue to establish a dataset that represents natural variability over time, as well as have a direct comparison during each monitoring year.

Because one of the goals of the spineflower introduction is to establish spineflower across ecoregions, comparison to reference sites within the known existing spineflower range may need to account for differences in climate, elevation, and other variables that could affect spineflower productivity. Thus, reference site data collected from the Santa Clarita population and the

Ahmanson Ranch population may not be directly comparable to the subset of introduction sites in different ecoregions and at higher elevations than currently occupied sites. Data collected annually from these introduction sites will be evaluated after 5 years of conducting biological monitoring of spineflower performance at these sites to examine the relationship of spineflower productivity, and whether separate standards should be applied to these introduction sites.

6.2 Installation Monitoring

The Project Biologist will make regular site visits during introduction and enhancement implementation. The Project Biologist will review all implementation activities for conformance to this Introduction Plan and any related environmental permit conditions. The Project Biologist will conduct pre-construction surveys/species relocation prior to implementation and will monitor the work areas during implementation for the occurrence of special-status species. The Project Biologist will coordinate with CDFW and/or USFWS, as appropriate, if there is an observance of a special-status species to determine the appropriate course of action. Additionally, the Project Biologist will ensure that if there is any vegetation clearing or ground disturbance planned, work is conducted in accordance with measures to protect nesting birds, as required by the Migratory Bird Treaty Act.

Each site visit conducted by the Project Biologist will be documented in an observation report. Photo-documentation of site conditions will be conducted as needed and will be included in the site observation reports, as appropriate.

6.3 Qualitative Monitoring Methods

Qualitative assessments of the introduction sites will be conducted on a regular basis to assess overall site conditions and maintenance activities. The purposes of the monitoring visits will be to document weed problems; document stages of growth, flowering, and seed production of spineflower within the introduction and reference sites; document herbivory problems; monitor soil stability; and monitor the general condition of the introduction sites. Specifically, qualitative monitoring will include the following:

- **Monitoring weed problems and thatch build-up.** Monitor the presence and level of weed problems on site with reference to the specific weed control program included in this Introduction Plan (Chapter 5, Maintenance Program). Make appropriate and timely weed control recommendations to the Landscape Contractor. Document levels of thatch build-up in the introduction areas compared to the reference area.
- **Monitoring the stages of spineflower growth, flowering, and seed production.** Monitor the life cycle stages of spineflower during qualitative monitoring visits in order to schedule timely quantitative monitoring during critical monitoring periods.

- **Monitoring herbivory problems.** Monitor and document evidence of herbivory of spineflower and make appropriate recommendations for herbivore protection/control, as necessary.
- **Monitoring soil stability, evident hydrology, and resistance to erosion.** Monitor the potential development of soil gaps and/or depressions that may form as a result of erosion or soil settling. If problems are detected and judged to be detrimental to the success of the program, provide remedial recommendations to repair any observed damage and to prevent future damage.
- **Rainfall and supplemental watering.** The Biological Monitor will monitor rainfall amounts from the nearest reliable weather station on a monthly basis to determine whether supplemental watering is needed during the first growing season. If supplemental watering is used, the Biological Monitor will monitor the amount of supplemental watering applied to the site.
- **Photo-documenting conditions on site.** Take representative photographs from fixed points within the introduction sites and at the reference site; photographs will include overall and close-up views from fixed viewpoints and from representative plots, allowing year-by-year comparison during the monitoring period.
- **Monitoring general site conditions.** Observe the general status of fencing, signage, perimeter control (trespass), and litter. Provide recommendations for maintenance needs to the Landscape Contractor.

6.4 Quantitative Monitoring Methods

Annual monitoring of the introduction sites will include at least three quantitative biological assessments each year, to be timed with the peak of the growing season before plants have begun to desiccate, during the flowering period of spineflower, and during seed set (approximately February, May, and June). Field-collected quantitative data will be used to evaluate the effectiveness of various treatments within planting plots and will provide a measure of the success of the spineflower introduction program relative to the reference sites.

The quantitative monitoring methods described in this section are established for the purpose of collecting adequate data to be able to analyze the relative success or failure of the introduction program in terms of achieving the project goals (see Chapter 7, Project Goals, Objectives, and Success Standards).

Quantitative monitoring will begin in the first year after establishing seeding trials. The expression of spineflower from a seed bank is highly dependent on weather conditions, particularly the timing and amount of rainfall (McGraw 2012). Thus, even in natural populations,

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these metrics are known to vary annually and substantially. As a consequence, the spineflower performance in this plan will be evaluated in the context of the results of reference site monitoring as described in Section 6.1, Establishment of Reference Sites. The following observations and measurements will be made during annual quantitative monitoring events.

6.4.1 Spineflower Density

The density of spineflower germinants will be evaluated and measured annually by counting spineflower plants within sampling areas located in introduction sites and at reference sites. The quantity and density of spineflower germinants, as estimated from sampling, will be compared between the introduction sites and the reference sites. The quantity of samples shall be determined by using a statistical power analysis.

6.4.2 Spineflower Seed Production

Spineflower seed production will be evaluated and measured annually by estimating seed production within sampling areas located in introduction sites and at reference sites. Seed productivity will be evaluated from representative random samples of a minimum of 10 plants per introduction site. The proportion of plants producing seed as well as the number of seeds produced per plant within each of the sampling areas will be calculated for comparison with reference sites.

6.4.3 Spineflower Seed Viability

Representative samples of seed will be collected from spineflower at the end of the growing season. Samples will be collected from introduction sites as well as reference sites. Seed viability will be evaluated from representative random samples from a minimum of 100 seeds total collected from a minimum of 10 plants per introduction site. The seed will be sent to a lab for viability testing. The viability testing will be based on standard laboratory procedures for testing seed viability, consisting of cold stratification and germination in petri dishes.

6.4.4 Spineflower Population Size

The spineflower population size will be a calculated estimate of the total number of plants at an introduction site using the density sampling values extrapolated across the area encompassed by occupied habitat. Occupied habitat will be mapped during the blooming period, and will be a measure of the aerial extent (i.e., acreage or square feet). The definition for occupied habitat aerial extent within introduction sites will follow the methods used to map occupied habitat for the existing Santa Clarita population for purposes of the SCP. The survey methods for mapping are based on mapping polygons with a heuristic association rule of 4 meters (13 feet). For example, if spineflower plants are located within 4 meters, they are combined into the same mapped polygon, whereas if plants are located at a greater distance than 4 meters apart, separate polygons are created. The area of polygons mapped as occupied habitat will be used with density sampling to calculate population size for each introduction site.

6.4.5 Spineflower Recruitment

One measure of successful establishment will be persistence of spineflower at the introduction sites. Persistence of spineflower is dependent on successful recruitment of new, reproductive spineflower plants contributing to the seed bank for future generations. Recruitment measured at an individual plant level is difficult to ascertain in the natural environment due to seed bank dynamics (e.g., seeds from different plants may respond differently to environmental conditions in any given year). Therefore, spineflower recruitment, as it contributes to presence, will be confirmed by documenting "spread" of spineflower beyond cumulative prior year occurrence boundaries. Additionally, spineflower recruitment will be assumed when multiple year-over-year germination occurs without supplemental seeding. This criterion therefore will be considered successful when recruitment has been documented in new areas outside of the cumulative footprint to date, and/or the individual occurrences are self-sustaining for a period of at least 5 years within the overall 10-year monitoring period.

6.4.6 Spineflower Areal Extent

The areal extent of occupied spineflower habitat will be quantified during the blooming period, as described in Section 6.4.4, Spineflower Population Size. Cumulative occupied habitat combines the acreage of the mapped polygons, and takes the largest footprint of occupied habitat over the course of successive annual periods. Thus, in some years when weather conditions are not conducive to spineflower growth, the occupied habitat may be much smaller than the cumulative occupied habitat. The validity of the cumulative occupied habitat will be evaluated against reference populations and rainfall data to ensure that it does not represent a shrinking occurrence in chronic decline that is not commensurate with what would be expected from natural population variation of the species. In other words, the boundaries of cumulative occupied habitat may need to be adjusted if the introduction sites demonstrate a sustained, multi-year, significant reduction in area that is not consistent with the reference population. The cumulative occupied habitat area will be updated annually, as necessary.

6.5 Monitoring Period

The monitoring period will commence upon initiation of seeding trials and continue for a period of 10 years. The schedule for biological monitoring will be determined each year by the growth and flowering activities of spineflower, based on fluctuating environmental/seasonal conditions. The optimum period for biological monitoring is anticipated to be in the months of February, May,

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and June, but will be timed to coincide with the estimated peak growth stage, blooming period, and seeding stage which can vary annually. Naturally occurring spineflower occurrences will be used to compare vegetative growth and flower production with the plants at the introduction sites in order to schedule monitoring events.

6.6 Annual Reports

An annual monitoring report will be prepared in the summer or fall of each year of the 10-year maintenance and monitoring period summarizing the information collected during that year's site visits. The annual monitoring reports will be submitted to the Spineflower Adaptive Management Working Group for review and comment on the current year summary and the proposed management actions for the upcoming year. Data will be summarized in tabular format where feasible. The annual monitoring reports, including collected data for each year, will be submitted to the centralized Spineflower Information Center that will be established as a requirement of the SCP. Newhall Land will be responsible for ensuring that the annual monitoring reports are submitted to the appropriate parties. Each annual report will include the following:

1. A description of the maintenance activities (e.g., seeding, weed control, watering, trash removal) conducted on the site during the previous year, including the dates on which the activities were conducted
2. A description of the existing conditions of the introduction sites, including descriptions of vegetation composition, weed species present in the introduction areas, and erosion problems
3. Qualitative and quantitative monitoring data related to proposed target goals; specifically, an estimate of the number of spineflower plants observed flowering, observations of seed production and natural recruitment, observations and estimates of mortality and suspected causes, and a comparison of data collected from the introduction sites and the reference site
4. Relevant weather conditions (including prolonged hot or cold periods), annual rainfall, and the response of introduction sites to changes in weather conditions, if detectable
5. A discussion of any problems encountered during the monitoring period
6. Recommendations for remedial measures to correct problems or deficiencies
7. Representative photographs of notable observations on site and from fixed photo points
8. Copies of field maps and data sheets

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7 PROJECT GOALS, OBJECTIVES, AND SUCCESS STANDARDS

The primary goal of the introduction program is to establish a minimum of two new self-sustaining and persistent spineflower populations at currently unoccupied sites across ecoregions. To this end, goals have been established herein that address spineflower abundance, extent, resilience and persistence at introduction sites.

7.1 Goals, Objectives, and Success Standards

Specific goals, objectives, and success standards are outlined in this section. The success standards are intended to function as interim measures to ensure that goals are achieved. Interim success standards will be evaluated on an annual basis, and if deficient, will trigger management actions designed to improve performance toward achieving the primary goal.

The overarching goal of establishing at least two self-sustaining and persistent spineflower populations applies across all introduction sites. Because introduction sites span the historically occupied elevational range of the species, not all introduction sites may be equally suitable for spineflower at a given time. Therefore, this Introduction Plan allows for flexibility in which locations are successful at establishing spineflower. Success standards related to plant performance as outlined below may be modified for sites located outside the current known elevation range of the species after an analysis of the performance of spineflower during initial test plots and early establishment phases at these locations (e.g., Elizabeth Lake and Ventura–Simi).

Program goals and objectives include the following:

Goal 1 **Abundance:** Establish occupied spineflower habitat that exhibits sufficient abundance to support a self-sustaining population.

Objective 1A: Measure the density of introduced spineflower plants at introduction sites compared to spineflower plants at designated reference sites. Plant density will be evaluated from representative random samples from a minimum of 100 1-meter-square samples per introduction site.

Success Standard: The introduced spineflower plants shall exhibit comparable levels of spineflower plant density compared to reference sites. Spineflower density within the introduction sites will be considered successful if the metrics are within the 95% confidence interval of the mean (two standard deviations) of historical baseline data collected from the reference sites.

Objective 1B: Measure the seed productivity of introduced spineflower plants relative to spineflower plants at designated reference sites. Seed productivity will be evaluated from representative random samples of a minimum of 10 plants per introduction site.

Success Standard: The introduced spineflower shall exhibit comparable levels of seed productivity compared to reference sites. Seed productivity at the introduction sites shall be within the 95% confidence interval of the mean (two standard deviations) of seed productivity measured at the reference sites.

Objective 1C: Measure the viability of seed produced by introduced spineflower plants compared to seed produced by spineflower plants at designated reference sites. Seed viability will be evaluated from representative random samples from a minimum of 100 seeds total collected from a minimum of 10 plants per introduction site.

Success Standard: The seed of introduced spineflower plants shall exhibit comparable levels of seed viability compared to reference sites. Seed viability at the introduction sites shall be within the 95% confidence interval of the mean (two standard deviations) of seed viability measured at the reference areas.

Goal 2 **Extent:** Establish self-sustaining spineflower populations at a minimum of two introduction sites, with at least one of the sites in a different ecoregion than the Santa Clarita population.

Objective 2A: Demonstrate that at least two introduction sites, with at least one site in a separate ecoregion, have a sufficient probability of survival over time.

Success Standard: At least two introduction sites, with at least one site in a separate ecoregion, shall each support a minimum viable population size[9] during Years 5–10 of the monitoring period.

[9] Minimum viable population (MVP) size has been described as the smallest number of individuals required for a 95% probability of survival over 100 years (Mace and Lande 1991, as cited in Pavlik 1996) (see Appendix I, Minimum Viable Populations for Annual Plants – Life History Parameters, for literature review of MVP). Based on life history characteristics, MVPs ranging from 50 to 2,500 individuals have been used for plants, where the lower quantity would apply to plants that are long-lived, woody, and self-fertile with high fecundity

Objective 2B: Demonstrate natural recruitment of introduced spineflower in at least two introduction sites, with at least one site in a separate ecoregion.

Success Standard: Natural recruitment of spineflower shall be documented outside of the footprint of the area seeded, or documented as recurring recruitment within seeded areas over a period of at least 5 years of the 10-year monitoring period without supplemental seeding, or both.

Goal 3 **Resilience:** Demonstrate resilience of the introduced spineflower occurrences.

Objective 3A: Document resilience of introduced spineflower following environmental stressors (e.g., drought).

Success Standard: Spineflower at introduction sites shall exhibit a stable or increasing trend (e.g., plant density, aerial extent) in 1 to 3 years following a poor spineflower year that resulted from an environmental stressor, unless poor conditions continue and/or reference populations show similar declining trends.

Goal 4 **Persistence:** Demonstrate persistence of spineflower at the introduction sites.

Objective 4A: Provide a minimum of 10 years of active adaptive management and in-perpetuity management thereafter of introduction sites.

Success Standard: Implement a minimum of 10 years of active adaptive management that includes addressing deficiencies if interim success standards are not met. The introduction sites shall be permanently conserved and adequate funding for in-perpetuity management shall be secured.

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and the higher quantity would apply to plants that are short-lived, herbaceous outcrossers (CPC 1991, Mace and Lande 1991, and Given 1994, as cited in Pavlik 1996). For spineflower, based on this approach, an MVP of at least 2,500 individuals is considered to be appropriate based on the life history characteristics (i.e., annual, outcrosser, herbaceous). Although this approach relies on generalizing the MVP for spineflower from data on other annual plant species, it provides a means to quantitatively evaluate establishment of spineflower in the context of the primary goal of establishing self-sustaining and persistent populations. Further research and monitoring should clarify the MVP for spineflower.

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Objective 4B: Implement a reporting program that provides comprehensive information about spineflower performance and conservation at the introduction sites.

Success Standard: Informative project reports and sufficient documentation shall be prepared annually to enable outside observers to understand potential reasons for shortcomings or success.

Objective 4C: Document persistence of spineflower at the introduction sites.

Success Standard: Spineflower at the introduction sites shall persist for a period of at least 3 years over the final 5 years of the initial 10-year adaptive management program without supplemental seeding or watering.

7.2 Project Completion

The determination of successful project completion shall be based on information collected annually from both the references sites and the introduction sites. Ultimate success will be determined based on the presence of self-sustaining and persistent spineflower populations at a minimum of two introduction sites, with at least one of the sites located in a separate ecoregion from the Santa Clarita population. The determination of whether or not the populations are self-sustaining and persistent shall be based on the achievement of the interim success standards as outlined in Section 7.1, Goals, Objectives, and Success Standards.

7.3 Contingency Measures

The expected result of the spineflower introduction program is to successfully establish spineflower at currently unoccupied introduction sites and demonstrate that the species is becoming self-sustaining and persistent at the introduction sites (see Section 1.8, Rationale for Success). However, it is possible that the spineflower will not become established or will be lost to other causes beyond the control of Newhall Land. If such events occur, then Newhall Land will reevaluate the introduction program in consultation with CDFW and USFWS and develop an appropriate course of action to either achieve the target number of self-sustaining populations or develop commensurate conservation measures that address the threats to the species.

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8 FUNDING

Initial implementation tasks, focusing on habitat enhancement and spineflower introduction, will be implemented by Newland Land, their assignee, or the designated land manager.

Newhall Land will fund seeding trials and all habitat enhancement and spineflower introduction activities within the Additional Conservation Areas during the initial implementation period. Initial implementation costs are currently estimated at Ex. 4 CBI Appendix J, Implementation and Long-Term Management Costs). As described above, broad-scale spineflower introduction efforts will be focused on sites within Additional Conservation Areas determined to provide the best chance of success, based on the spineflower seeding trials. However, because Newhall Land will conduct at least 10 acres of spineflower introduction across the Additional Conservation Areas regardless of which areas are selected as the focus for the introduction efforts, the cost of these initial implementation tasks is expected to remain approximately the same as currently estimated.

For ongoing (in-perpetuity) management, Newhall Land will fund an endowment(s) to support perpetual management and monitoring of the spineflower introduction sites within the Additional Conservation Areas, based on a Property Analysis Record, currently estimated at Ex. 4 CBI (Appendix J). The endowment required for each Additional Conservation Area will be finally determined prior to beginning long-term management within that Additional Conservation Area. The endowment will fund management activities of the entire Additional Conservation Area, including the spineflower introduction and enhancement sites, starting in Year 11. Intensive management activities will be focused on the introduction sites and immediately surrounding buffer areas as described in Section 9.2, Initial Management. If an Additional Conservation Area is not selected for broad-scale spineflower introduction, or if spineflower introduction activities do not succeed within the Additional Conservation Area, long-term management will be limited to general maintenance and reporting as described in Section 9.3, Ongoing Management. While the amount required to fund the endowment for a particular Additional Conservation Area that lacks any introduction sites may be significantly reduced because many management tasks would be inapplicable (see Section 9.3), the total amount committed to funding the endowments is expected to remain approximately the same as currently estimated (see Appendix J).

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9 MANAGEMENT FRAMEWORK

There are three spatial scales relevant to management, including the introduction sites (specific locations where spineflower seed is applied), the buffer enhancement areas (approximately 50-foot buffer surrounding introduction sites), and the Additional Conservation Areas (the larger areas encompassing the introduction sites). Each management area has a separate level of management intensity, with the introduction sites requiring the greatest management effort and the Additional Conservation Areas (outside of introduction sites) requiring the least. Management of the introduction sites and the buffer enhancement areas will be governed by the maintenance and monitoring components of this Introduction Plan (see Chapter 5, Maintenance Program, and Chapter 6, Monitoring Program). Any necessary management of the larger Additional Conservation Areas outside of the introduction sites and the buffer enhancement areas will be implemented under an in-perpetuity management framework, with a designated land manager and assured funding. The assumptions used to identify the tasks and associated costs for the management of Additional Conservation Areas and spineflower introduction sites and an overview of the initial management phase, the ongoing management phase, and the adaptive management program are provided in the following sections.

9.1 General Management Assumptions

The spineflower introduction sites include those located on land owned by Newhall Land and those located near Elizabeth Lake owned by Land Veritas. Not all of these lands may ultimately support persistent spineflower populations. Locations where spineflower establishes as persistent, self-sustaining populations (as defined by the success standards outlined in Chapter 7), will be conserved and managed over the long term (see Figure 4). For successful spineflower introduction sites on Newhall Land property, the introduction sites and the surrounding areas dedicated as Additional Conservation Areas under this Introduction Plan will be protected in perpetuity through the establishment of permanent conservation instruments recorded by Newhall Land. For the lands near Elizabeth Lake, Land Veritas will place a conservation easement over the introduction sites and surrounding areas. For all successful introduction sites, long-term management will occur consistent with this Introduction Plan.

Management is assumed to occur in two phases for each Additional Conservation Area: (1) an initial management phase occurring concurrent with the implementation of spineflower introduction (Years 1–10) and (2) an ongoing management phase that will occur in perpetuity starting in Year 11, or when the project goal is met as defined in Chapter 7. Funding for these phases is described in Section 8 of this Introduction Plan. A cost estimate that itemizes the tasks and costs for implementation and land management is provided in Appendix J.

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9.2 Initial Management

The initial management period will occur during the first 10 years of spineflower establishment, concurrently with implementation of spineflower introduction and habitat enhancement for each phase. Implementation (as described in Chapters 4, 5, and 6 of this Introduction Plan) will be focused on spineflower introduction and habitat enhancement in specific areas (see Figures 6-1 through 6-6). These areas include the selected introduction sites and a 50-foot area surrounding the introduction sites. Management of the other portions of the Additional Conservation Areas where spineflower introduction and enhancement is not occurring will be conducted during the first 10-year period and will include the following:

- **Conservation instrument dedication:** Activities associated with restrictive covenant or conservation easement documentation, legal description, and recordation.
- **General maintenance:** General maintenance of the Additional Conservation Areas includes addressing access controls (e.g., signs and fencing at key locations).
- **Annual reporting:** Annual monitoring reports with general information about the managed lands will be prepared. These reports will focus on documenting the conditions and management of the overall Additional Conservation Area as related to general maintenance and land management. Preparation of the annual report for the initial management period will be the responsibility of the Land Manager.

9.3 Ongoing Management

The ongoing (i.e., in-perpetuity) management phase will begin in Year 11, or when success standards are met, and continue in perpetuity. These activities will be funded by the non-wasting endowment and implemented by the designated Land Manager. The Land Manager will be responsible for ensuring that each of the management activities is completed as required. Consistent with the long-term management of the SCP spineflower preserves, ongoing long-term management activities for the spineflower introduction sites and buffer areas will include the following:

- **Biotic surveys:** Activities associated with annual spineflower introduction site monitoring, quarterly spineflower qualitative monitoring, spineflower aerial extent monitoring, and preserve vegetation monitoring.
- **Habitat maintenance:** Activities associated with annual exotic plant monitoring/control and annual Argentine ant monitoring/control.
- **Public services:** Annual patrolling and enforcement for access control.
- **General preserve maintenance:** Annual maintenance of fencing/signage and trash removal.

- **Annual reporting:** Includes activities associated with data management, management plan updates, monitoring data, public outreach, and quarterly/annual reports. Annual reports will be submitted to the Spineflower Adaptive Management Working Group for review and comment. The annual monitoring reports, including collected data for each year, will be submitted to the centralized Spineflower Information Center.
- **Office maintenance and equipment:** Allowances for manager's office and field equipment.
- **Operation and administration:** Allowances for operational costs, contingency and administrative costs, and spineflower emergency response and adaptive management fund.

Ongoing management of portions of the Additional Conservation Areas other than the spineflower introduction sites and 50-foot buffer areas will include general maintenance and annual reporting as described in Section 9.2.

9.4 Adaptive Management Program

This Introduction Plan will follow the approach of the adaptive management program described in the SCP, which includes a framework to support the conservation goals for spineflower. The natural variability inherent with spineflower populations requires the adoption of a flexible, programmatic, adaptive management approach. For example, the natural variability in the observed population levels can interfere with detecting the effects of non-natural factors.

Monitoring will be tied directly to management actions (i.e., "effectiveness" monitoring), such that management can be evaluated as having the desired effect of maintaining or enhancing spineflower populations. Adjustments to the annual work plans will rely on feedback from monitoring activities and on newly available information (e.g., scientific research) to guide changes in management activities or overall strategy. Adjustments to management will also be made based on the response of spineflower to experimentally designed small-scale management trials. Input from the Spineflower Adaptive Management Working Group will be sought to guide the management, monitoring, and planning activities of the adaptive management program of this Introduction Plan.

A fundamental element of the adaptive management program is a repeating process of periodic review, short-term adjustment, and long-range planning. Each annual report will include an evaluation of the success of completed management actions to date, a summary of new management actions and objectives, and an annual work plan for the implementation of management actions in the upcoming year.

Information sharing is a critical component of the adaptive management program. Information collected under this Introduction Plan will be retained in a repository for annual work plans and monitoring data. Regional weather data, local weather information, and raw monitoring data will also be stored and accessible in the centralized repository. The centralized repository will be the Spineflower Information Center created under the SCP, which will provide centralized storage and facilitate a structured flow of information related to all aspects of spineflower adaptive management.

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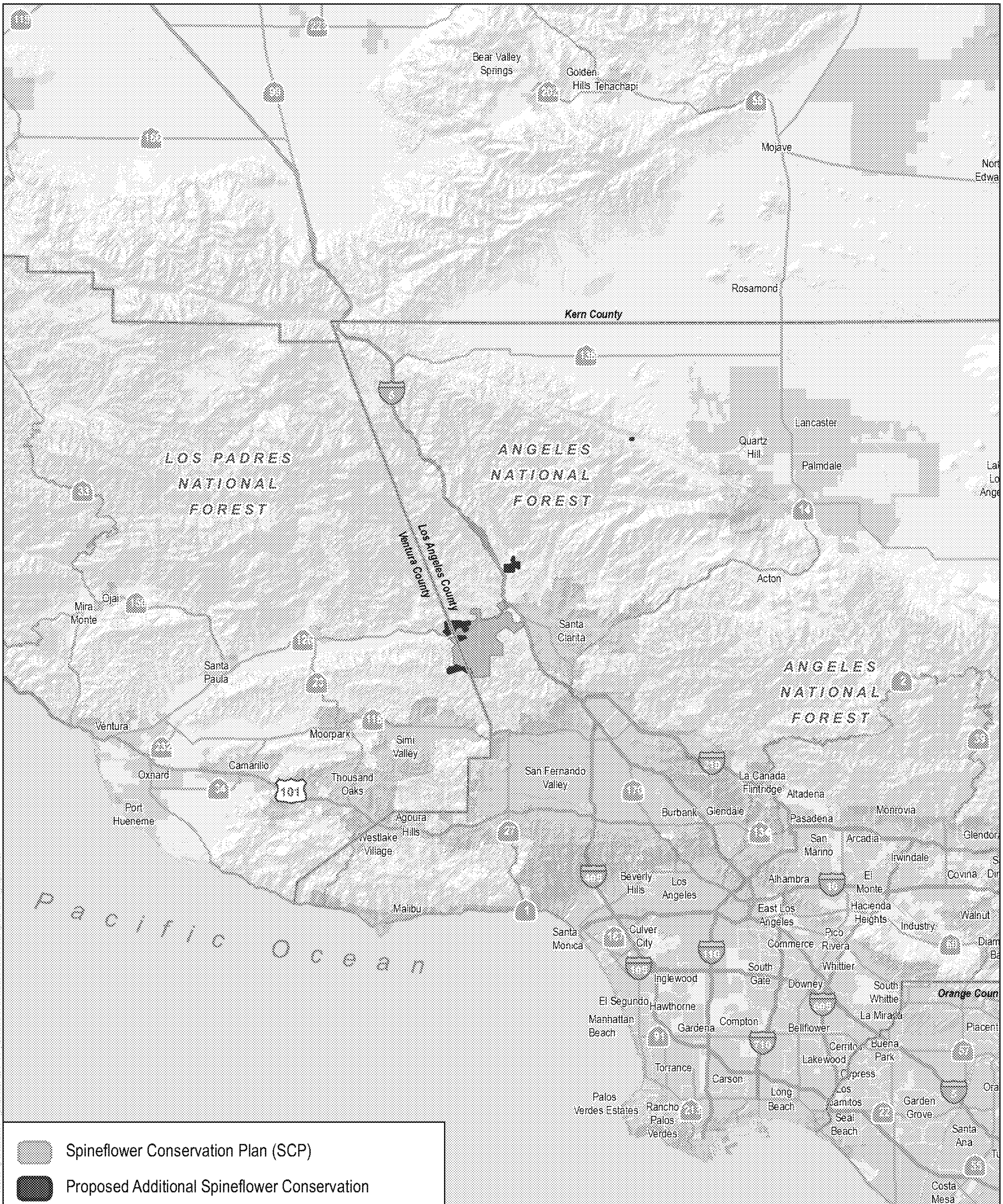

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FIGURE 1
Regional Map

San Fernando Valley Spineflower Introduction Plan

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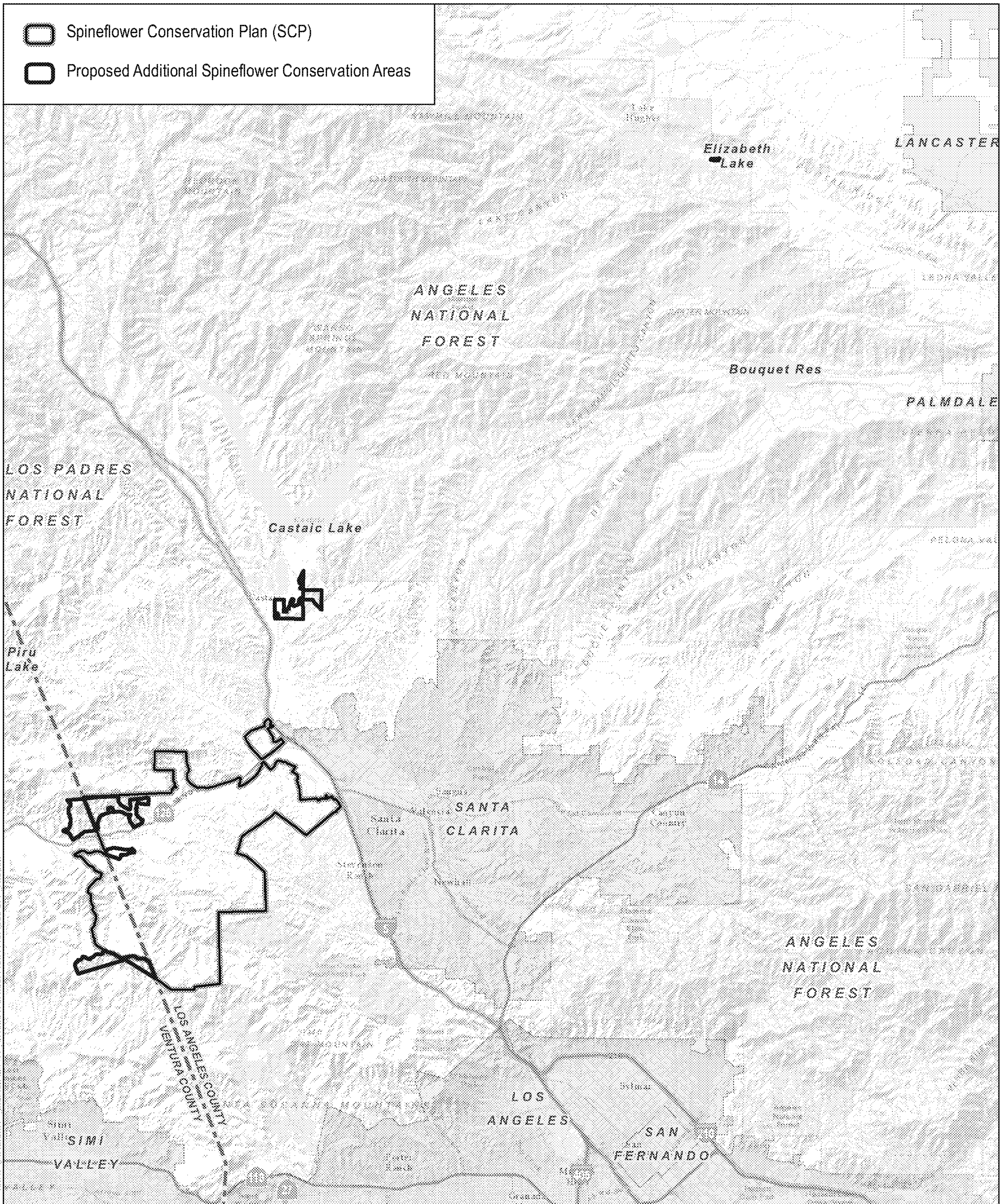

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FIGURE 2
Project Vicinity

San Fernando Valley Spineflower Introduction Plan

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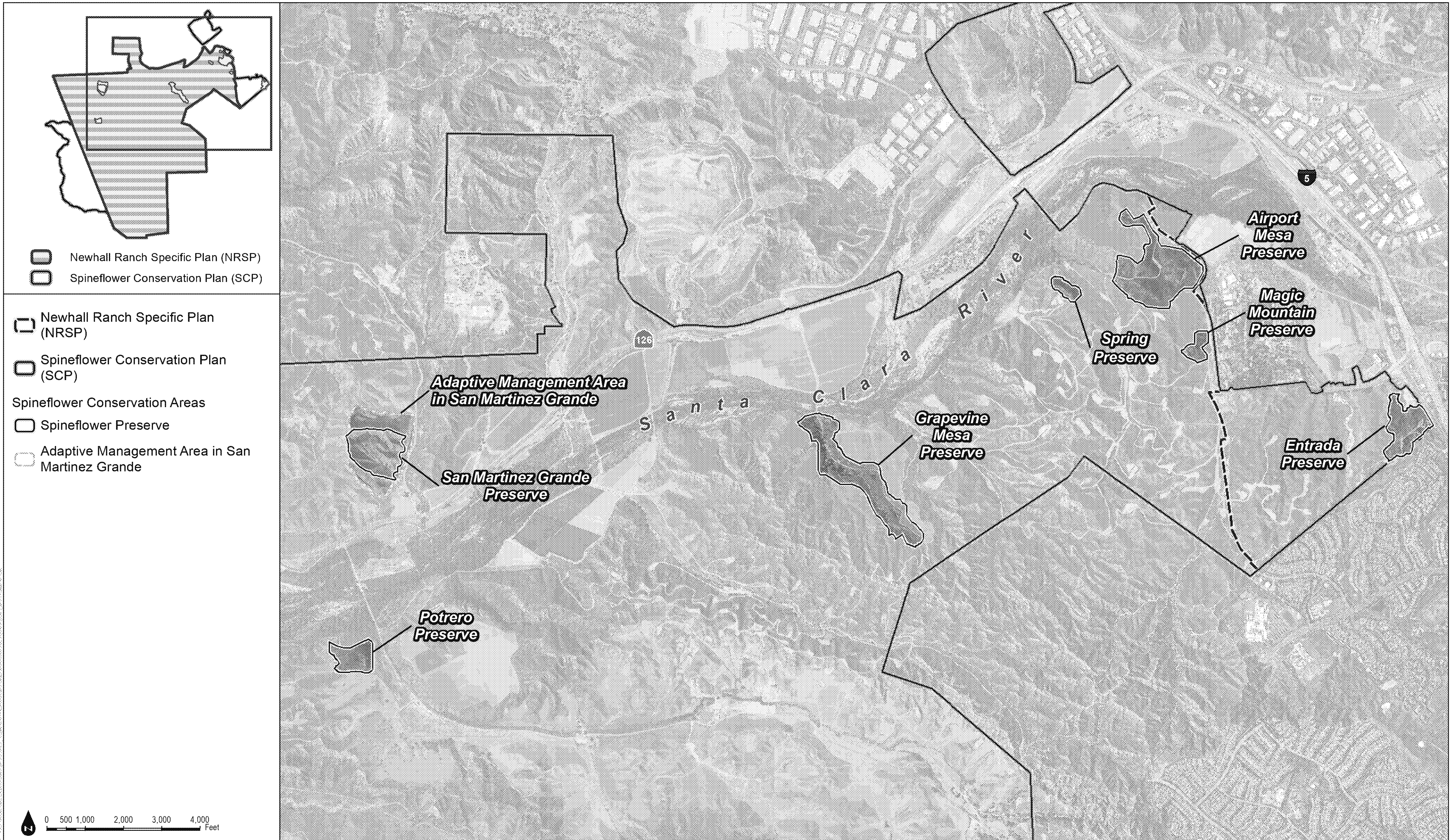

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SOURCE:

FIGURE 3

Spineflower Conservation Plan and San Fernando Valley Spineflower Preserves

San Fernando Valley Spineflower Introduction Plan

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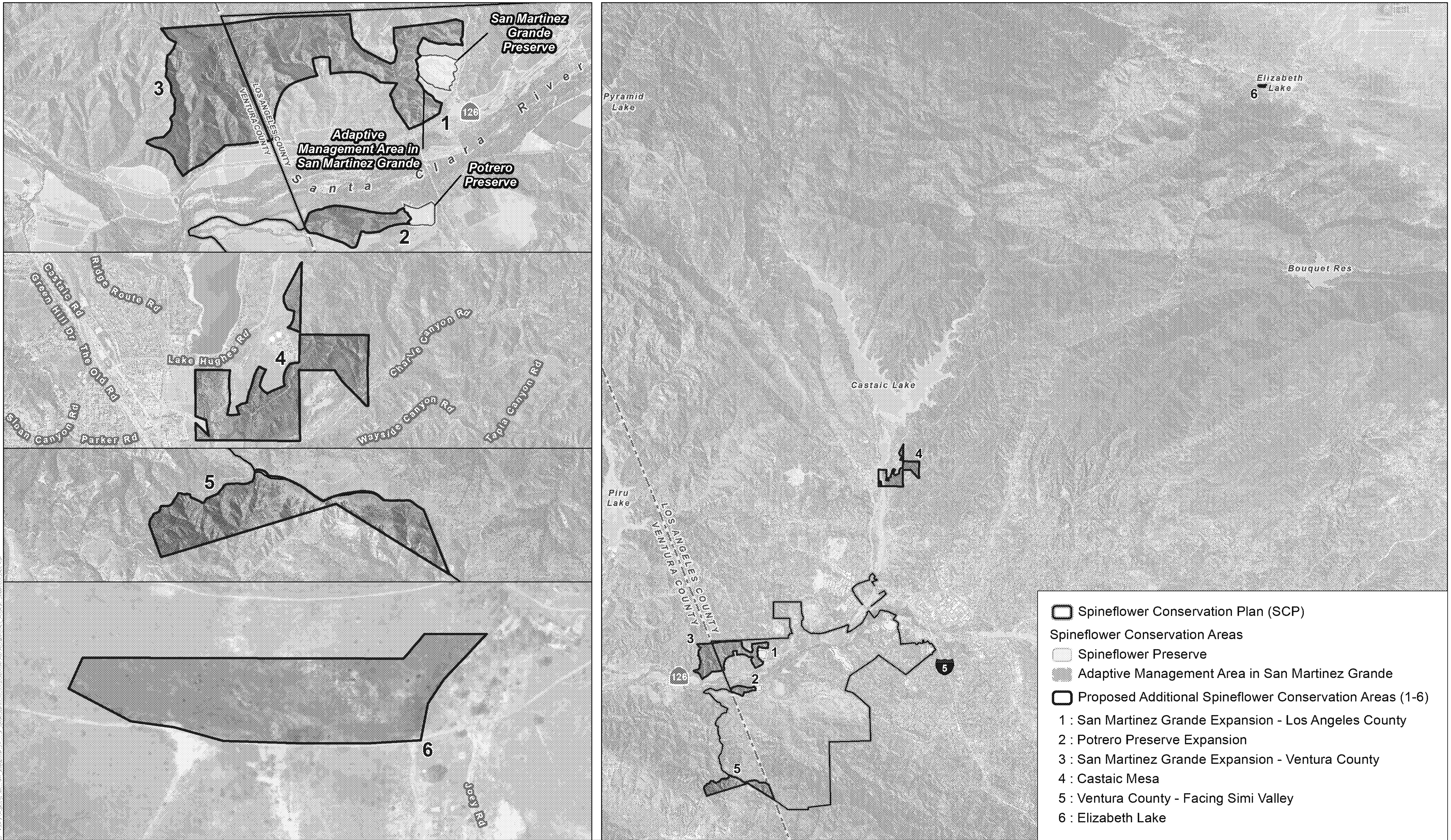

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0 0.5 1 2 3 4 5 Miles

FIGURE 4

Proposed Additional Conservation Areas for Enhancement and Introduction

San Fernando Valley Spineflower Introduction Plan

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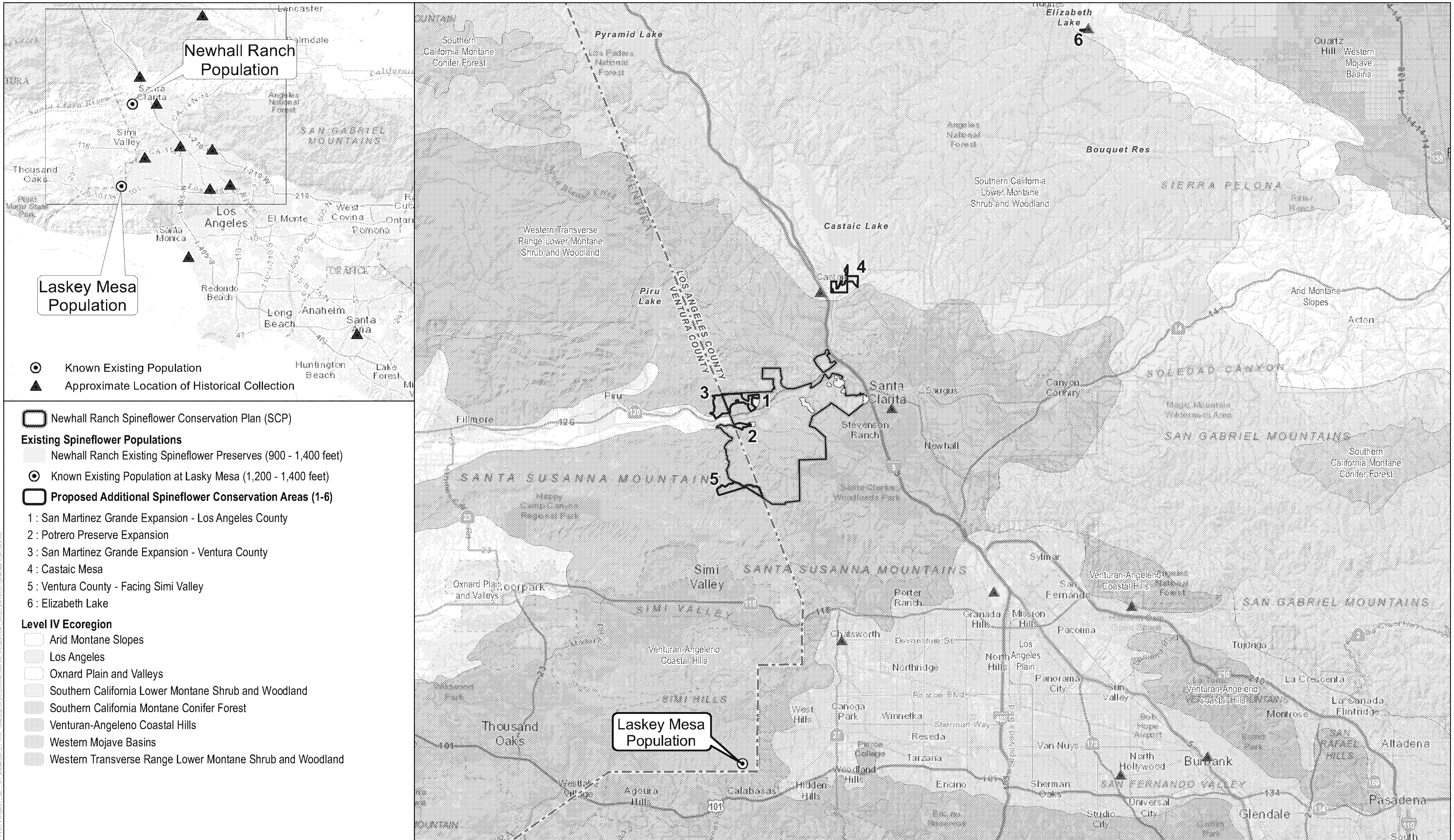

FIGURE 5

Historic and Existing Spineflower Populations with Proposed Additional Conservation Areas

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San Fernando Valley Spineflower Introduction Plan

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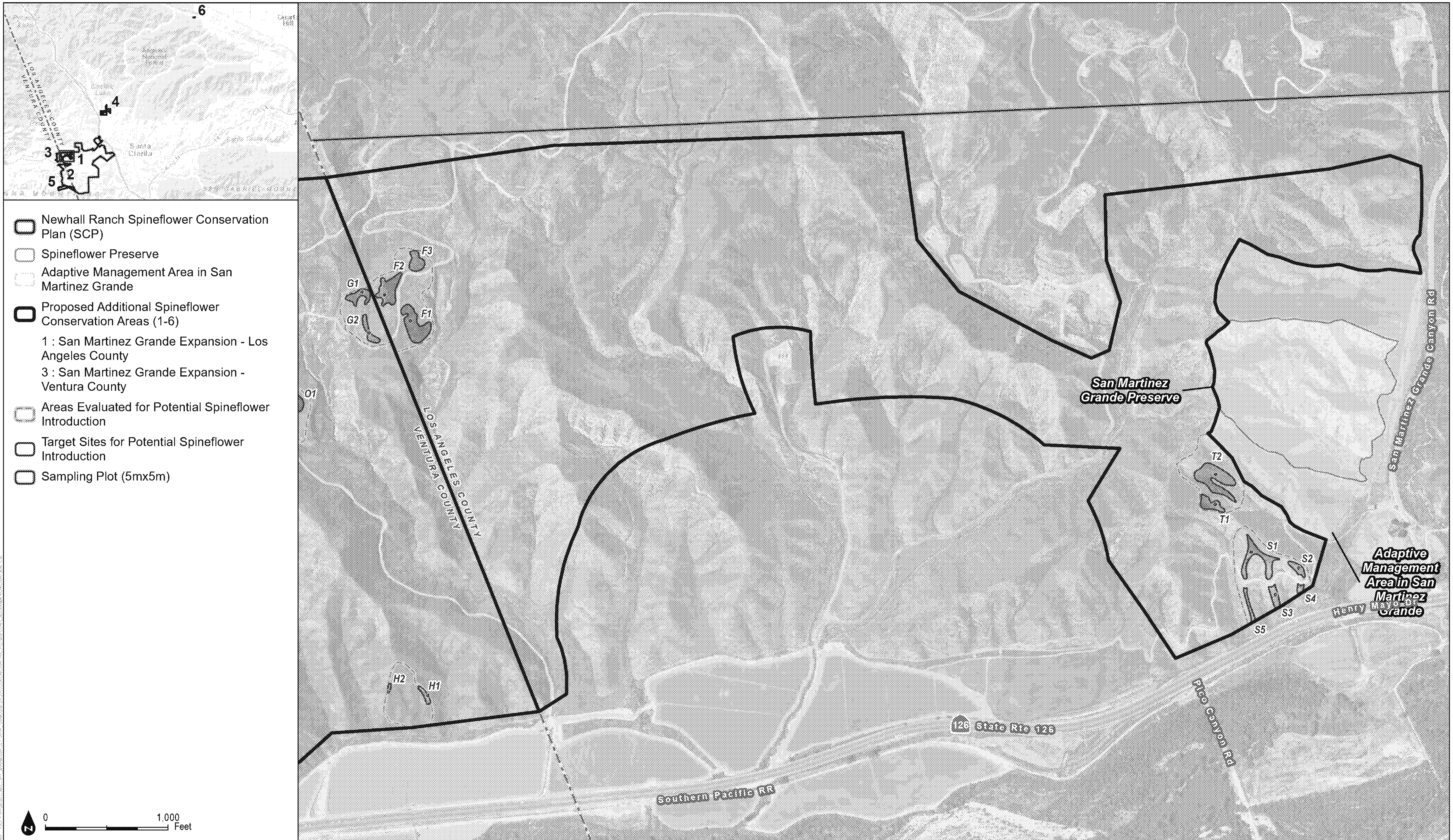

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FIGURE 6-1

Proposed Spineflower Introduction Sites in Conservation Area #1 : San Martinez Grande Expansion - Los Angeles County

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FIGURE 6-3

Proposed Spineflower Introduction Sites in Conservation Area #3 : San Martinez Grande Expansion - Ventura County

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FIGURE 6-2
Proposed Spineflower Introduction Sites in Conservation Area #2 : Potrero Preserve Expansion

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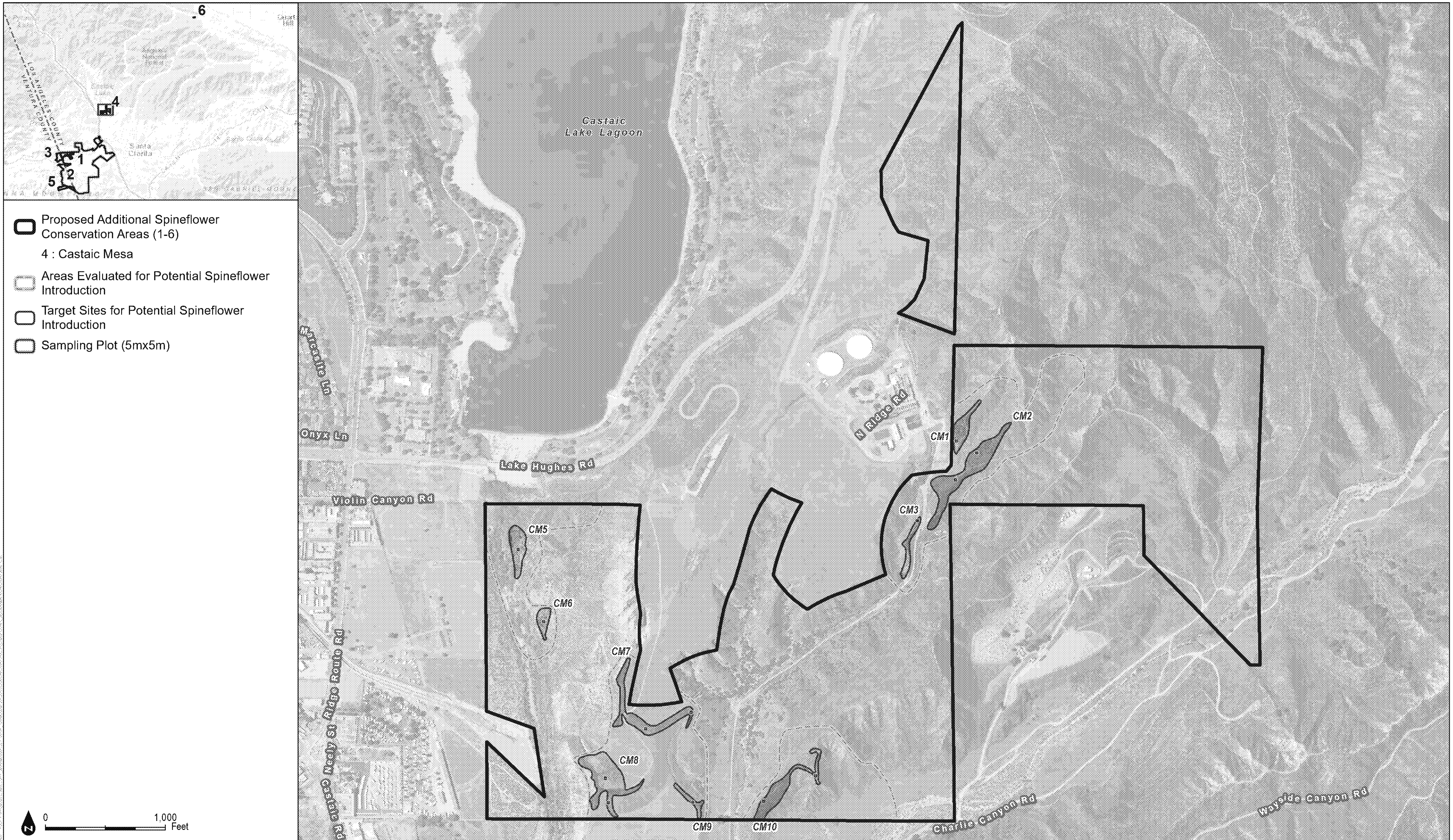

FIGURE 6-4
Proposed Spineflower Introduction Sites in Conservation Area #4 : Castaic Mesa

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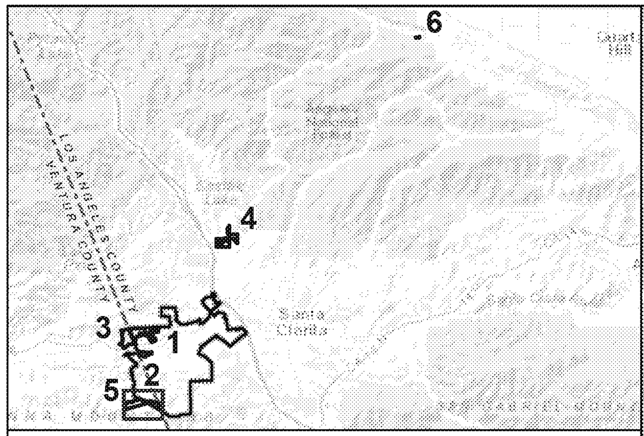

Newhall Ranch Spineflower Conservation Plan (SCP)

Proposed Additional Spineflower Conservation Areas (1-6)

5 : Ventura County - Facing Simi Valley

Areas Evaluated for Potential Spineflower Introduction

Target Sites for Potential Spineflower Introduction

Sampling Plot (5mx5m)

0 1,000 Feet

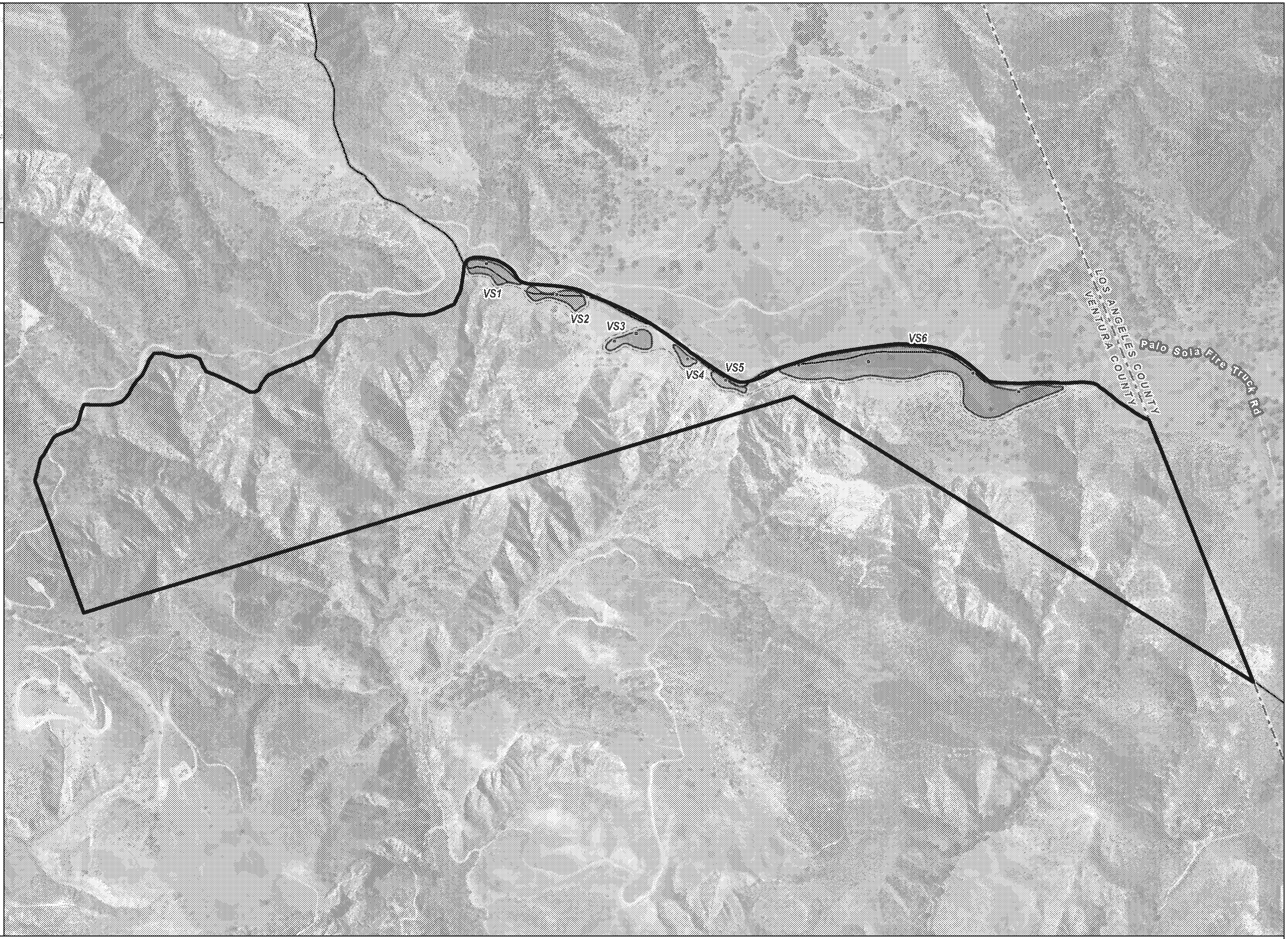

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FIGURE 6-5

Proposed Spineflower Introduction Sites in Conservation Area #5 : Ventura County - Facing Simi Valley

San Fernando Valley Spineflower Introduction Plan

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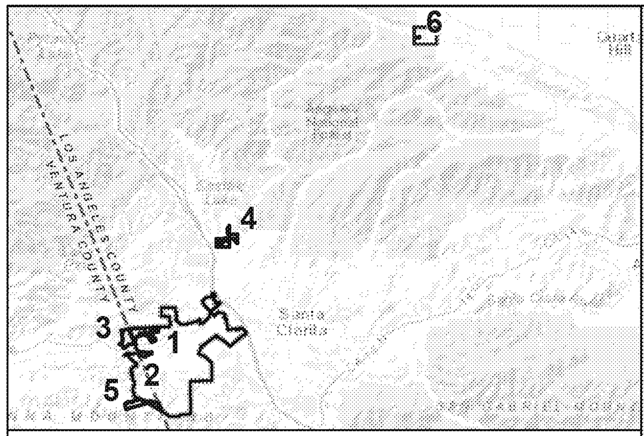

Proposed Additional Spineflower Conservation Areas (1-6)

Target Sites for Potential Spineflower Introduction

Sampling Plot (5mx5m)

0 875 Feet

DUDEK

FIGURE 6-6

Proposed Spineflower Introduction Sites in Conservation Area #6 : Elizabeth Lake

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APPENDIX A

San Fernando Valley Spineflower Habitat Characterization Study

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TECHNICAL MEMORANDUM

TO: Sam Rojas and Matt Carpenter; Newhall Land and Farming

FROM: Jodi McGraw

DATE: April 29, 2016

SUBJECT: San Fernando Valley Spineflower Habitat Characterization: Summary of Factors to Visually Assess Potential Suitability of Unoccupied Habitat for Experimental Introductions

CC: Andy Thompson, Kathleen Dayton, and Sherri Miller, Dudek Associates, and Nathan Gale and Anuja Parikh, FLx.

Purpose

This memo identifies observable abiotic and biotic conditions of habitat within the Newhall Ranch Study Area that are positively associated with San Fernando Valley spineflower distribution (*Chorizanthe parryi* var. *fernandina*). It is provided to Newhall Land and Farming, Dudek Associates, and Flx to aid collective efforts to identify areas of potentially suitable but unoccupied habitat, where future experimental introductions could be conducted to recover the endangered plant.

Introduction

Newhall Land and Farming Company (Newhall Land) prepared a Spineflower Conservation Plan (Plan), which describes the preservation, habitat management, and monitoring that will be conducted to mitigate the impacts of development as part of the Newhall Ranch Specific Plan on the San Fernando Valley spineflower (*Chorizanthe parryi* var. *fernandina*), a California endangered plant species (Dudek Assoc. 2010). Developed in consultation with the California Department of Fish and Wildlife (the Department), the Plan calls for a habitat characterization of the San Fernando Valley spineflower (spineflower) to be conducted at the outset of Plan implementation, to increase understanding of the factors that influence the distribution, abundance, and individual and population performance of the spineflower in order to inform effective long-term management and monitoring.

In 2014, Jodi McGraw Consulting (JMc) initiated a study to characterize the habitat for SFVS by comparing a suite of abiotic and biotic conditions in 51 randomly located plots in areas occupied by spineflower to those in 51 randomly located plots located in areas of unoccupied habitat[1]. Within

[1]Occupied areas were with the cumulative footprint of spineflower between 2002 and 2013 (Dudek 2013), and featured spineflower spring 2014. Unoccupied areas were outside of the cumulative spineflower footprint and a buffer of 20 feet, but within mapped grassland or coastal scrub communities; they did not feature spineflower during spring 2014.

occupied plots, the study evaluated spineflower density and size, to assess factors that influence plant performance.

The study used a nested sampling design to characterize habitat at two scales: habitat was evaluated in 5 m x 5m plots, and microhabitat was assessed in 1m x 1m plots. Soil samples collected from the top 6" in the center of the nested study were analyzed by a soils laboratory which provided information about soil chemistry and texture.

To develop this memo, the data collected were evaluated to address the following questions***: What observable abiotic and biotic conditions are positively (or negatively) associated with spineflower occurrences in the Newhall Ranch Study Area, and can be used to select areas for quantitative evaluation of their suitability for potential experimental introductions of the species to expand its distribution and abundance?***

Results of the assessment are designed to inform field-based assessment of potentially suitable habitat in spring 2016, in which habitat characteristics will be measured following the methods used in the 2014 study. This will enable data collected from within occupied habitat in 2014 to be compared to that collected in 2016 within apparently suitable but unoccupied habitat, to quantitatively evaluate suitability based on additional, unobservable characteristics, such as soil chemistry.

Results

Table 1 lists the factors that are positively or negatively associated with San Fernando Valley spineflower distribution and that can be assessed as part of initial reconnaissance of potentially suitable but unoccupied habitat. For each factor, the table identifies the measures evaluated in the habitat characterizations, the interpretation in light of the species ecological model, and their implications for selecting or screening sites for potential future experimental introductions. Such spineflower introductions are likely to be successful in sites that meet a high percentage of the abiotic and biotic habitat conditions summarized below.

<u>Abiotic Characteristics</u>

- Benches, rounded ridgetops, or the upper third of hillslopes, which likely feature thinner and less developed soils, which reduce competition from dense herbs and shrubs.
- Rounded or linear topography.
- Slope gradients of less than 32 degrees
- Slope aspects between 120 and 240 degrees, where higher solar radiation limits dense growth of herbaceous plants and shrubs that can outcompete the diminutive herb.
- Soils with a relatively high proportion of sand (>50%), which similarly limit the density of more competitive plants.

<u>Biotic Characteristics</u>

- Limited cover of litter or thatch (<30%) and woody debris (<10%) at the habitat level, and feature microhabitat areas that feature even less cover of such plant material (litter <10% and woody debris <3%), which likely inhibit spineflower establishment and also reflect dense growth by exotic grasses and native shrubs that compete with spineflower.
- Chronically disturbance, due to erosion, animal trails, or animal diggings, at least in a portion of the habitat area (>20%), to maintain areas of low litter and plant competition.
- Sparse shrub cover (<20%).
- At the microhabitat scale, areas with low cover (<5%) of highly-competitive exotic annual grasses, including ripgut brome (*Bromus diandrus*), red brome (*Bromus madritensis* ssp. *rubens*), and slender oat (*Avena barbata*), which create density litter and compete with spineflower for aboveground resources and light.
- Relatively high diversity of other native annual forbs, including those species identified as positive indicator species (below); and
- Relatively high proportion of the following positive indicator species, which occur at high relative frequency and abundance in occupied habitat and therefore likely reflect suitable habitat conditions:
    - *Acmispon strigosus*
    - *Erodium cicutarium*
    - *Schismus barbatus*
    - *Trichostema lanceolatum*
    - *Pectocarya linearis ssp. ferocula*
    - *Eriogonum fasciculatum var. foliolosum*
    - *Eschscholzia californica*
    - *Lupinus bicolor.*

- Relatively low proportion of the following negative indicator species, which are positively associated with unoccupied habitat generally found on cooler, north-facing slopes and/or more developed soils, and therefore likely indicate areas that are not suitable for long-term persistence of the species.
    - *Artemisia californica*
    - *Salvia leucophylla*
    - *Bromus diandrus*
    - *Mirabilis laevis var. crassifolia*

Appropriate Uses and Potential Limitations

These observable factors can aid initial, visual assessment of the suitability of unoccupied habitat for spineflower introduction. Within areas identified as potentially suitable, quantitative data should be collected following methods similar to those used in the 2014 habitat characterization study, to enable quantitative analyses to evaluate suitability of new locations based on multiple factors including those that are not visually observable (e.g. soil pH).

Annual climate including most notably, the amount and distribution of precipitation, can greatly influence herbaceous plant species structure and composition in the region, such that measures from 2014 may not reflect habitat conditions in 2016. If weather patterns in 2016 were very different from those in 2014, abiotic factors such as topography, slope gradient, slope aspect, and soil texture and chemistry, as well as the cover of disturbance and shrubs, may provide to be more reliable indicators of potentially suitable habitat than more ephemeral measures such as exotic annual grass cover and perhaps indicator species.

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Table 1: Visually observable characteristics of spineflower habitat that can be used to evaluate suitability of sites for species' introductions.

Factor	Scale	Parameter	Values in Occupied Spineflower Habitat	Results	Interpretation	Implications for Experimental Populations/Recovery
Topography	Macro	Landform	Ridgetops, benches, and upper slopes	Occupied plots were primarily located on benches, ridgetops, and the upper third of slopes, whereas unoccupied habitat plots were largely located on slopes.	Ridges, benches, and upper slopes likely have thinner soils and receive greater insolation, than middle and lower slopes. This reduces the density of woody and competitive exotic grasses relative to that observed on deeper, more developed soils.	Select areas on ridges, benches, and the upper 1/3 of hillslopes that do not exceed 32 degrees, as noted below.
	Micro	Surface Shape	Rounded or linear (less often concave)	Microtopography was similar in occupied and unoccupied habitat, both of which were convex (rounded) or linear.	Areas with concave microtopography would likely feature greater soil moisture and thus soil development and vegetation, and should probably be avoided.	Select areas that are convex or linear but not concave.
Elevation	Habitat	Feet Above Mean Sea Level	1,007-1,462 feet (mean=1,146, SD=97)	Spineflower occurs within a relatively narrow range of elevations, relative to that found in Newhall Ranch. Unoccupied plots sampled west of San Martinez Grande and in the "Uplands" (SW) of the property were at high elevation (maximum=1,512 for SMG West and 2,575 for Uplands)	Spineflower occurs in lower elevation areas within Newhall Ranch.	Decisions about elevation should be informed by the species' historical known occurrences throughout its range, and landscape scale analysis of the occupied patches. That said, it is 'safe' to select sites between 1,007 and 1,462 feet in elevation (that meet other criteria).
Aspect	Habitat	Slope Aspect	36-270 degrees (mean is meaningless)	Compared to unoccupied plots, occupied plots occurred within a narrower range of aspects that were more easterly, southerly, and westerly than unoccupied habitat.	Spineflower preferentially occurs on more easterly, southerly, and westerly aspect.	Select sites with an aspect between 120 and 240 (unless an explicit goal of the study is to evaluate establishment in cooler slopes).
		Adjusted Slope Aspect (absolute	2-156 degrees (mean=45.6, SD=36.6)	Occupied plants averaged lower adjusted aspect and occurred within a narrow range of adjusted aspects (mean=45.6, SD=36.6) than unoccupied	Spineflower preferentially occurs on more easterly, southerly, and westerly aspect.	Select sites with an adjusted slope aspect of 60 or less (unless an explicit goal of the study is to evaluate establishment in cooler slopes).

Table 1: Visually observable characteristics of spineflower habitat that can be used to evaluate suitability of sites for species' introductions.

Factor	Scale	Parameter	Values in Occupied Spineflower Habitat	Results	Interpretation	Implications for Experimental Populations/Recovery
		value of aspect -180)		plots (mean =73.9, SD=60.1). The 68% confidence interval of the mean for occupied habitat includes 31.6 – 50.1.		
Slope Gradient	Habitat	Slope degrees	1-32 degrees (mean=16.3, SD=7.7)	Occupied plots ranged between 1 and 32 degrees slope and overall averaged lower slope (mean=16.3, SD=7.7) than unoccupied habitat (mean=24.8, SD=8.6)	Spineflower preferentially occurs on more gently sloped terrain than occurs throughout the study area; however, slopes of various gradients between 1 and 32 degrees were observed in occupied habitat.	Select areas with a slope gradient of no more than 32 degrees.
Soil Type	Habitat	Mapped Soil Unit (GIS)	Variable	No clear relationship between sampled plots and mapped soil types, though a disproportionate number of spineflower plots are in what is mapped as Terrace Escarpments.	Soil mapping units are likely too coarsely mapped to differentiate soils at least based on the characteristics that influence spineflower.	Landscape analysis in GIS using mapped spineflower polygons might prove more fruitful; alternatively, variable soil conditions within soil mapping units may make mapped soil types less useful for choosing sites.
Soil Color	Habitat	Munsell Soil Color Classifications	Scores based on hue, value, and chroma.	Soils colors positively associated with occupied habitat (10YR 5/4 and 10YR 5/8, which are yellowish brown) are similar to and therefore could be readily confused with soils that are associated with unoccupied habitat (e.g. (10YR 6/4, which is light yellowish brown).	Soil color is difficult to accurately classify and/or does not reflect soil conditions relevant to spineflower.	Soil color is not likely to be useful for diagnosing potentially suitable habitat.
Soil Texture	Habitat	Sand Content (Percent of soil particles between 2mm and 0.062 mm diameter)	18.8%-77.9% (mean=54.3%, SD=13.7)	Occupied habitat averaged higher mean sand content and had a narrower range (mean=54.3%, SD=13.7) than unoccupied habitat (mean=41.3%, SD=20.7). Plots in Potrero Mesa West (Preserve) and East (south of the ag fields on top of the mesa) are notably outliers, and have just 20 and 40% sand.	Spineflower is adapted to droughty soil conditions that are less likely to support dense competitors (shrubs and dense herbaceous plants).	Sites with a high proportion of sand (e.g. >50%) will likely be more suitable for spineflower in the long term, as they are less likely to support dense (exotic) grasses and/or native shrubs. It is unclear why Potrero Mesa differs in soil texture as well as spineflower associates (e.g.

Table 1: Visually observable characteristics of spineflower habitat that can be used to evaluate suitability of sites for species' introductions.

Factor	Scale	Parameter	Values in Occupied Spineflower Habitat	Results	Interpretation	Implications for Experimental Populations/Recovery
						black sage). Selecting sites in this area with lower thresholds for sand content could enable evaluation of the effects of soil texture on spineflower performance during a potential experimental introduction.
Litter	Habitat	Litter Cover	0.5%-70% (mean=13.5%, SD=15.4)	Occupied habitat averaged lower cover of litter/thatch (mean=13.5%, SD=15.4) on the soils surface than observed in unoccupied habitat (mean=31.4, SD=26.2). Three occupied plots featured 60-70% litter, but the remaining 48 had just 0.5-30% litter cover.	Spineflower occurs in areas of greater lower cover of leaf litter and thatch from prior year's herbaceous plants. This cover is reduced as a result of disturbance (e.g. trails, gopher mounds, slides) or and/or is lower due to lower productivity of herbaceous plants, which reflects the lower fertility/water holding capacity of the sandier soils.	Select sites with low litter cover (<30% across the broader area), particularly those where it appears to be edaphically driven or otherwise sustained, as opposed to the result of ephemeral disturbances.
	Microhabitat	Litter Cover	0-60% (mean=7.9, SD=12.5)	Within occupied habitat, spineflower preferentially occurs in areas of lower litter cover (mean=7.9, SD=12.5) than found in adjacent areas where the plant is not observed (mean=32.3, SD=27.7)	Microsites in which spineflower can become established feature very little litter, which mechanically inhibits seedlings establishment and also generally occurs in areas of greater cover of herbaceous plants and shrubs, which outcompete the annual forb.	Select sites that have virtually bare-soil (litter <10%) as these microhabitats will promote spineflower, and their occurrence likely reflects appropriate abiotic conditions (inimical soils and exposed aspects) as well as biotic conditions (lower competition for soil resources and light).
Woody Debris	Habitat	Woody Debris Cover	0-40% (mean=8.9, SD=10.4)	Occupied plots averaged lower cover of woody debris from shrubs (mean=8.9, SD=10.4) than unoccupied habitat (mean=15.6, SD=17.7)	Spineflower preferentially occurs in areas of sparse shrub cover, where the debris from woody plants on the soil surface is lower. This debris can mechanically impede	Select sites with low cover (e.g. <10%) of woody debris on the soil surface.

Table 1: Visually observable characteristics of spineflower habitat that can be used to evaluate suitability of sites for species' introductions.

Factor	Scale	Parameter	Values in Occupied Spineflower Habitat	Results	Interpretation	Implications for Experimental Populations/Recovery
					spineflower establishment, while the shrubs that produced if, it if alive, can also create competition for light.	
	Microhabitat	Woody Debris Cover	0-30% (mean=1.8, SD=6.1)	Occupied microhabitat averaged very low cover of woody debris on the soil surface (mean=1.8, SD=6.1) when compared to adjacent unoccupied microhabitat (mean=22.3, SD=29.5)	As described above, woody debris can mechanically impede spineflower seed germination; it may also be an indicator of lower light environments where shrubs are present.	Select sites features areas that lack woody debris (e.g. <3%) on the soil surface.
Disturbance	Habitat	Percent of area disturbed	0-85% (mean=27.5, SD=26.7)	A greater percentage of occupied habitat plots, on average (mean=27.5, SD=26.7) evidenced disturbance caused by digging animals, trails, or erosion (e.g. sheet wash, rilling, or dry ravel) than was observed in unoccupied habitat (mean=12.6, SD=19.0). A similar pattern was observed at the microhabitat level.	Spineflower is promoted by disturbances which maintain open habitat (bare ground) and reduced competition, which promotes seedling establishment, growth, and survivorship to reproduction.	Select areas that feature a high percentage (>20%) of bare ground that is likely to be maintained over time due to ongoing disturbance (e.g. animal trails, slides on steep slopes, etc.).
Plant Community Structure	Habitat	Shrub Cover	0-43% (mean=8.7%, SD=9.3)	All but six of the 51 occupied plots had shrub cover ≥20%.	Spineflower preferentially occurs in open areas dominated by herbaceous plants, or in the gaps between relatively sparse shrub cover	Select areas that with only scattered shrubs (≤20%).
	Habitat	Native Annual Forb Species Richness	2-12 species (mean=4.9, SD=2.5) per 25 m^2	Occupied plots averaged greater richness of native annual forbs (mean=4.9, SD=2.5) than unoccupied plots (mean=3.2, SD=2.1)	Spineflower occurs in areas that support a greater diversity of other native annual forbs, which may also be disturbance-adapted/poor competitors.	Select areas with a relatively high diversity of other native annual forbs (see indicator species list below).
	Microhabitat	Exotic Annual Grasses	0-30% cover (mean=3.1, SD=5.8)	Occupied microhabitat (i.e. where spineflower is rooted) had lower cover of exotic annual grasses	Exotic annual grasses including Bromus madritensis ssp. rubens	Select sites with low cover of exotic annual grasses other than *Schismus* barbatus—a

Table 1: Visually observable characteristics of spineflower habitat that can be used to evaluate suitability of sites for species' introductions.

Factor	Scale	Parameter	Values in Occupied Spineflower Habitat	Results	Interpretation	Implications for Experimental Populations/Recovery
				(mean=3.1, SD=5.8) than unoccupied microhabitat located near spineflower (mean=8.1, SD=11.4).	and Avena barbata are highly competitive for limited soil resources and can create dense litter on the soil surface, which impede spineflower.	diminutive and therefore not terribly competitive grass that is a positive indicator of spineflower habitat as noted below.
Plant Species Composition	Habitat	Positive Indicator Species	Species list	The following species occurred at significantly greater frequency and abundance in habitat occupied by spineflower, than habitat that was not occupied: • *Acmispon strigosus* • *Erodium cicutarium* • *Schismus barbatus* • *Trichostema lanceolatum* • *Pectocarya linearis ssp. ferocula* • *Eriogonum fasciculatum var. foliolosum* • *Eschscholzia californica* • *Lupinus bicolor.* The following additional species were marginally non-significant positive indicators: • *Centaurea melitensis* • *Lasthenia californica* • *Logfia filaginoides* • *Chaenactis glabriuscula* • *Salsola tragus*	These species may feature similar ecology to spineflower and could be indicators of areas where the plant will perform well.	Select areas that feature multiple positive indicators, while avoiding areas that feature multiple negative indicators (see list below)
		Negative Indicator Species	Species List	The following species occurred at significantly lower frequency and abundance in habitat occupied by spineflower, than habitat that was	These species occur on cooler, moister north-facing slopes, and more well-developed soils;	Avoiding areas that feature multiple negative indicators and support multiple positive indicators (above)

Table 1: Visually observable characteristics of spineflower habitat that can be used to evaluate suitability of sites for species' introductions.

Factor	Scale	Parameter	Values in Occupied Spineflower Habitat	Results	Interpretation	Implications for Experimental Populations/Recovery
				not occupied: • *Artemisia californica* • *Salvia leucophylla* • *Bromus diandrus* • *Mirabilis laevis var. crassifolia* The following additional species were marginally non-significant negative indicators: • *Calystegia macrostegia* • *Chorizanthe staticoides* • *Medicago polymorpha*	therefore, they indicate areas where spineflower is likely to be outcompeted over time.	

APPENDIX B

San Fernando Valley Spineflower Habitat Manipulation and Seeding Experiment

San Fernando Spineflower Habitat Manipulation and Seeding Experiment

Introduction

Newhall Land and Farming Company (Newhall Land) prepared a Spineflower Conservation Plan (SCP), which describes the preservation, habitat management, and monitoring that will be conducted to mitigate the impacts of development as part of the Newhall Ranch Specific Plan on the San Fernando Valley spineflower (*Chorizanthe parryi* var. *fernandina*), a California endangered plant species (Dudek 2010). The plan called for development of the Spineflower Enhancement Program (Dudek 2014), which identifies how seed salvaged from planned development areas will be used to establish spineflower occurrences in open space areas in an effort to expand preserve populations and as part of experiments designed to inform conservation and management of the species.

To inform implementation of the SCP and Spineflower Enhancement Program, biologists from Jodi McGraw Consulting conducted a habitat characterization of the San Fernando Valley spineflower (spineflower) to increase understanding of the factors that influence the distribution, abundance, and individual and population performance of the spineflower. The three annual studies conducted between 2013 and 2015 identified a suite of abiotic and biotic factors that are correlated with spineflower distribution, abundance, and individual plant performance, and therefore may influence the suitability of habitat for spineflower (McGraw, in prep, McGraw 2015a,b). It also suggested three habitat conditions, soil compaction, exotic plant abundance, and soil moisture availability, could influence effectiveness of efforts to establish spineflower as part of the Spineflower Enhancement Program.

This study is designed to test hypotheses for factors that influence suitability of habitat for spineflower, examine the effectiveness of habitat treatments designed to establish spineflower occurrences, and compare two alternative seeding methods for introductions as part of the enhancement program. Specifically, it was developed to address the following questions:

1. What are the independent and interactive effects of soil compaction, soil moisture availability, and exotic plant competition, on spineflower performance, including seedling establishment, survivorship, growth, and reproduction?
2. How does spineflower performance in response to the treatments differ among sites which vary in prior land use, soil texture and chemistry, and plant community composition?
3. Does spineflower performance differ in plots established through translocating salvaged topsoil scraped from occupied spineflower habitat compare to broadcasting spineflower seed?

Methods

To address the study questions, we will conduct small-scale manipulations of habitat and seeding methods and evaluate how they influence aspects of spineflower individual plant performance. The treatments will be conducted in experimental plots located in 10 locations (blocks), which were identified as apparently suitable for spineflower based on a series of habitat indicators (Figures 1 and 2). Variation in spineflower responses to the treatments will be used to evaluate how variable site conditions including aspects of soils, plant community composition, and land use, influence spineflower performance directly and indirectly, through the habitat manipulations

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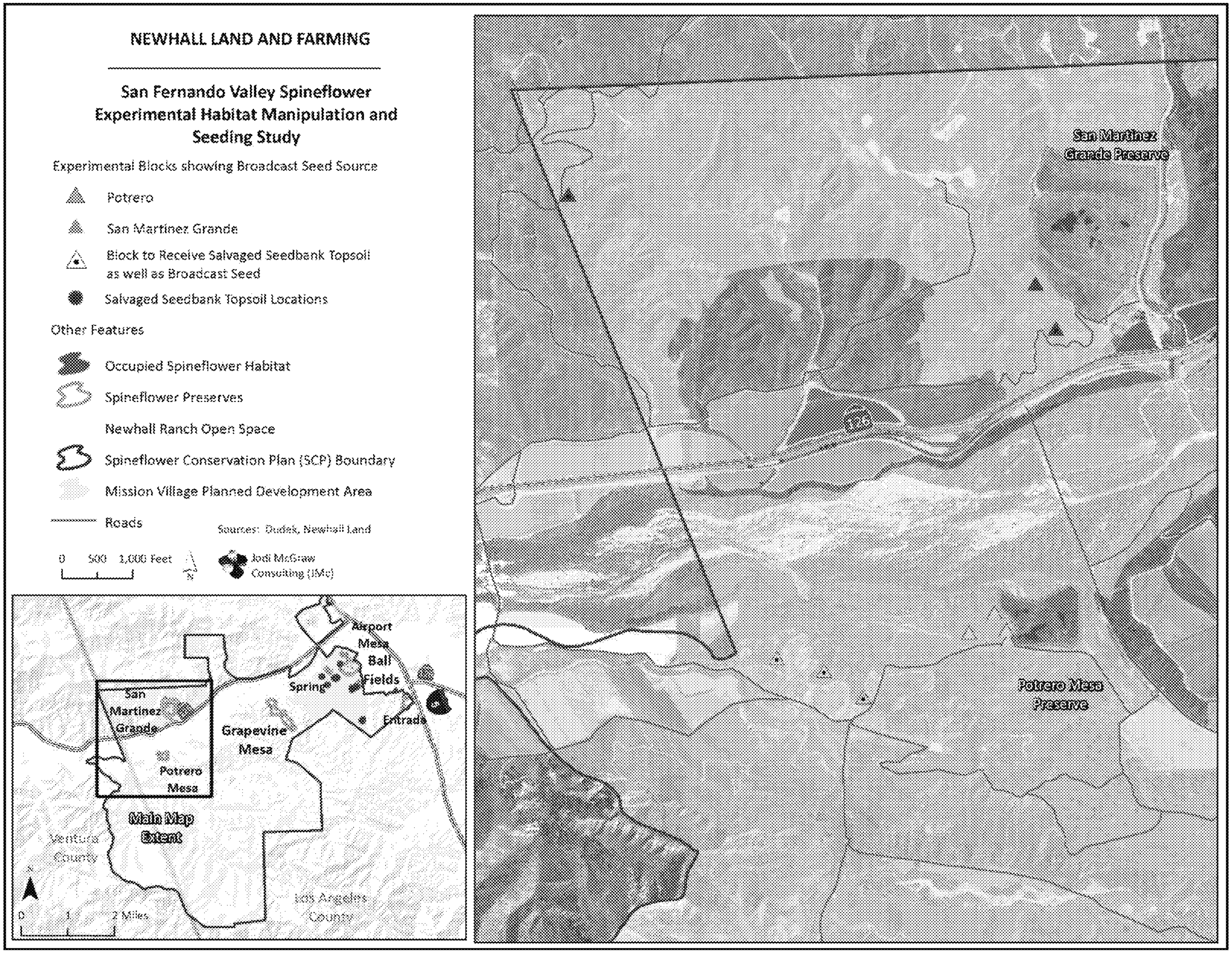

Figure 1: Experimental Habitat and Seeding Study Location

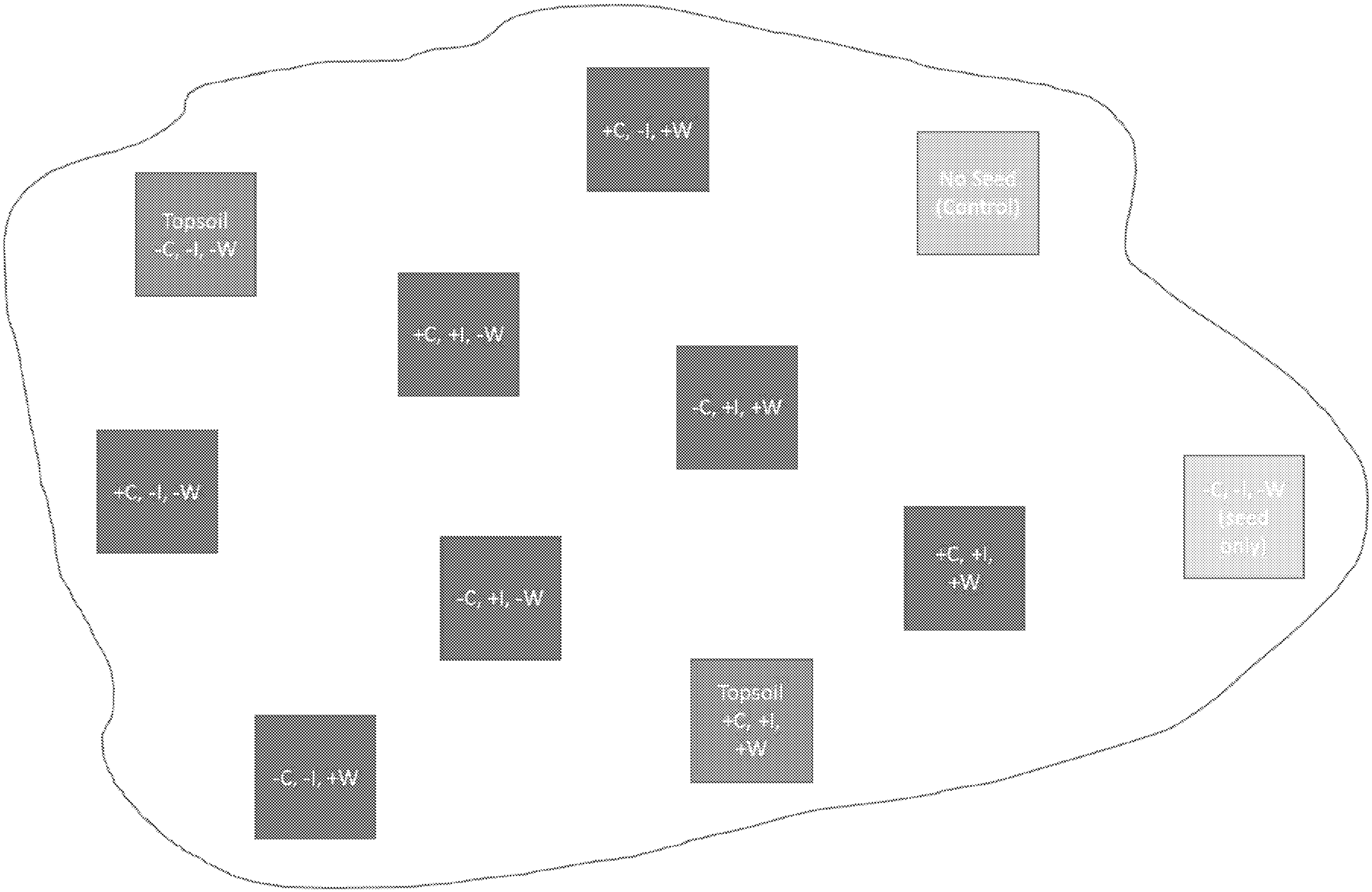

Figure 2: Experimental block design, showing plots that will be broadcast seeded (green) and those that will receive salvaged seedbank topsoil (orange), and the following habitat treatments: soil compaction (+C), irrigation (+I) and weeding (+W). Blocks located within 1,000 feet of existing spineflower will only feature plots that are broadcast seeded (no salvaged seedbank topsoil).

Study Sites

The study will be conducted within the western portion of Newhall Ranch in northwestern Los Angeles County, California. The study sites are located on land owned by Newhall Land and Farming, that will be permanently protected as part of the Newhall Ranch Specific Plan (Figure 1; *Conservation Considerations*). Specifically, the experimental blocks will be located near the Potrero Mesa and San Martinez Grande preserves, in areas lacking existing spineflower occurrences, but that feature habitat that appears suitable for spineflower. Potentially suitable sites were selected using a three-step process in which site suitability criteria derived through a analyses conducted as part of the spineflower habitat characterization were applied iteratively, at increasingly finer spatial scales, to identify suitable habitat and select sites for the study (McGraw 2016a, b).

In the first step, Dudek biologists used a geographic information system (GIS) to identify areas that featured three abiotic characteristics associated with spineflower distribution at the landscape scale:

1. Slope between 0° and 30°;
2. Aspect between 120° and 240°; and
3. Elevation below 1,500 feet above mean sea level.

In the second phase, the twenty-one sites that generally fit the GIS-modeled selection criteria were examined by Drs. Nathan Gale and Anuja Parikh, who delineated the boundaries of areas featuring visible positive indicators of occupied spineflower habitat (McGraw 2016a):

1. **Topography:** benches, rounded ridgetops or the upper third of hillslopes;
2. **Soil texture**: coarse textured (i.e. sandy soils);
3. **Litter and Woody Debris:** limited cover of litter (<30%) and woody debris (<10%) on the soil surface;
4. **Disturbance:** visibly disturbed soil due to erosion, animal trails, or animal diggings (>20%);
5. **Shrub Cover:** cover of woody shrubs less than 20%;
6. **Native Annual Forbs:** a relatively high diversity of other native annual forbs including those identified as positive indicator species;
7. **Indicator species:** a relatively high diversity and abundance of positive indicator species (species that are more abundant and/or more frequently in areas occupied by spineflower than those that are not) and conversely, a low diversity and abundance of negative indicators (species preferentially found in areas lacking spineflower).

In the third step, 30 of the candidate sites mapped in step 2 were quantitatively sampled using methods similar to those applied in the habitat characterization, to enable quantitative comparisons of their habitat conditions to those in occupied spineflower habitat. Drs. Gale and Parikh assessed plant community structure and species composition in a 5 m x 5m quadrats randomly located in each mapped site. Andy Thomson then measured soil compaction and collected soil samples which were analyzed for their texture and chemistry.

The quantitative data were used to score the 30 sites based on their suitability, using 11 variables that were found to be significant indicators of spineflower habitat: slope, aspect, elevation, silt content, pH, organic matter, ammonium nitrate, soluble potassium, soluble calcium, manganese content, and native annual forb richness (McGraw 2016b). For each variable, sites with a value within the range of occupied areas sampled as part of the habitat characterization were given a score of 1. Scores were summed and those with a score of 8 or higher were considered suitable for the experimental trials. From these, 10 blocks (Figure 1) were selected from areas where land will be permanently protected within the Newhall Specific Plan Area (*Conservation Considerations*).

Study Design

Within each of the 10 areas of potentially suitable habitat (blocks), we will randomly locate eight, 1.5 m x 1.5 m plots which will be used to test the effects of three habitat treatments.

In five of the areas, which are more than 1,000 feet away from occupied habitat (B2, C1, F1, P2, and S1), we will establish two additional plots to compare a broadcast seeding method to a method that relies on translocating salvaged topsoil containing spineflower seedbank (*Seed Treatment*)

All plots will be permanently monumented using 12" metal stakes (i.e. nails) and georeferenced using a GPS. Plots will be randomly assigned to receive one of the designated treatments (Figure 2).

Site Preparation

All plots will be raked to remove woody debris (e.g. branches) and thatch build up on the soil surface, which have been found to be negatively associated with spineflower distribution and abundance (McGraw, *in prep.*). Raking will occur throughout the plot, even in areas of open bare soil, to control for the effect of raking. Raked material will be disposed of off-site or away from the block.

Habitat Treatments

The following treatments will be conducted in combination with broadcast seeding in a fully-factorial design to evaluate the effects of these habitat conditions on spineflower performance.

1. **Compaction (+C):** To examine the effects of soil compaction, the surface of the (dry) soil will be compacted to 300 psi using a soil compactor (rammer or tamper) before seeding. If water is needed to achieve compaction, soils will be moistened and compacted, and allowed to dry completely prior to seeding.
2. **Weeding (+W):** To test the effects of exotic plant competition, all exotic plants will be removed using hand pulling and clipping/weed whipping. Exotic plant treatments will be conducted at approximately three intervals during the growing season, with the precise timing depending on plant phenology, which is strongly influenced by precipitation:
    a. After green up (December or January);
    b. Just prior to peak physiology (February/March); and
    c. During onset of flowering (April/May).
3. **Irrigation (+I):** To evaluate the effects of soil moisture on spineflower, supplemental water will be provided during drought (periods of no rain lasting at least 2 to 3 weeks) within the growing season. The timing of irrigation will be determined based on the precipitation and observation

of plant conditions. All plots assigned to the irrigation treatment will receive 1" of rainfall (i.e. 15 gallons per plot), applied using a low-flow, highly dispersed application that will limit runoff.

Seeding Treatment

We will test the relative effectiveness of two methods of seeding on spineflower performance.

Broadcast Seed

Each of the eight broadcast seed plots will be seeded with 0.2 g of seed, which contains approximately 494 seeds (RSABG 2015). Total seed used would be approximately 39,520 (10 blocks x 8 plots/block x 494 seed/ plot).

Seed will be dispersed evenly within the plot and lightly raked with a landscape rake to increase soil-to-seed contact. Seed will not be buried more than 5 mm below the soil surface.

Salvaged Seedbank Topsoil

In the five blocks located at least 1,000 feet from occupied spineflower habitat (Figure 1), we will establish two additional plots that will receive salvaged seedbank topsoil. In each plot, the soil surface will be excavated to a depth of one inch and then seedbank topsoil salvaged in 2014 from the Mission Village Development Site (Figure 1) and currently stored *ex situ* will be spread to a depth of 1 inch. The surface contours will be matched at the tie-in points of the receptor site so the receptor site follows the natural contours. This treatment will not be conducted in the five blocks located within 1,000 feet of occupied spineflower habitat, to reduce the risk of genetic contamination (*Genetic Considerations*).

The two salvaged topsoil plots will be randomly assigned to one of two habitat manipulation combinations: no compaction, no weeding, and no irrigation, and plus compaction, plus weeding, and plus irrigation (Figure 2). This will enable comparison of the effects of adding topsoil to that of broadcast seeding, with and without habitat manipulations designed to improve conditions for spineflower performance.

Data Collection and Analysis

Data Collection

We will collect data for spineflower performance, as well as habitat conditions, to facilitate evaluation of the mechanisms by which the treatments influence spineflower. To limit edge effects, we will collect all measurements within the central 1 m x 1 m portion of the 1.5 m x 1.5 m treatment plots.

Spineflower

To assess treatment effects on spineflower performance, we will measure the following:

1. Density: number of reproductive (flowers/fruits produced) and non-reproductive (i.e. seedlings) spineflower plants;

2. Vegetative Plant Size: Longest leaf length of five randomly selected non-reproductive spineflower plants; and
3. Reproductive Plant Size: The area of the inflorescence, measured as an ellipse, of five randomly selected reproductive spineflower plants.

Plots will be sampled to measure the above variables at three intervals during the first growing season:

1. Within 3 to 5 weeks of the first germinating rains, to gauge initial germination;
2. In ~ February/late March, during peak physiology; and
3. In ~May, during peak flowering.

At the end of the growing season (e.g. late June or July), we will collect five reproductive spineflower plants from each plot, to measure the following:

1. Reproductive Plant size, as above;
2. Flower Production: number of flowers; and
3. Seed Set: proportion of flowers producing seed on plants; and
4. Seed Viability: Proportion of fruits that are viable.

Habitat Conditions

During the flowering period (~May), we will also measure the following habitat conditions to evaluate how they influence spineflower performance:

- Plant species composition: cover of other plants by species, which will be used to calculate plant community structure based on life history and origin guilds (e.g. exotic annual grasses, native perennial herbs, etc.);
- Soil compaction;
- Thatch cover; and
- Disturbance cover.

Data Analysis

We will explore the data using a suite of descriptive and inferential statistical analyses to address the study questions. To evaluate the effects of soil compaction, irrigation, and exotic plant control, we will use a four-way ANOVA with the three habitat treatments as fixed factors, and block as a random factor. To evaluate the effects of broadcast seeding versus salvage seedbank topsoil, we will perform a three-way ANOVA with seed treatment and habitat manipulation as fixed factors, and block as a random factor.

When block (as a factor) is statistically significant, either independently or in combination with habitat treatments and seeding treatments, we will perform use Tukey pairwise comparisons to test for significant differences among blocks. Additionally, we will use descriptive analyses and other inferential statistical analyses, such as linear regression, to explore habitat factors within blocks that may influence spineflower performance directly or indirectly through the habitat and/or seeding treatments.

The results of the study will be integrated within the broader ecological model for spineflower, which is being developed based on the habitat characterization and prior studies within the site (McGraw *in prep.*).

Study Considerations

This section provides additional information about how the study addresses the Department's requirement for reducing genetic contamination and ensuring that any introduction sites are conserved.

Genetic Considerations

The CDFW 2081(a) application for plants states that "Moving plants, seeds, or pollen from one location or population of the plant to another is generally discouraged, unless it is part of an overall recovery program, because of the possibility of genetic contamination of local natural populations. Proposals involving such movement must include justification of why this design is necessary and must address the possibility or likelihood of contamination. Methods to prevent any possible genetic contamination should be discussed."

Several aspects of the study are designed to minimize the risk of genetic contamination by reducing the potential for seed dispersal and pollination between plants from non-local sources and those within existing populations.

1. **Experimental blocks are not occupied**: The experimental blocks and the larger surrounding areas that were evaluated have been surveyed over multiple years by biologists with expertise in identifying spineflower and have been determined to be unoccupied. Therefore, seeding in these areas does not pose a risk of contaminating locations within or near the blocks.
2. **Broadcast seed is sourced from the nearest occurrences**: The seed that will be used in the study will come from collections obtained from the nearest spineflower occurrences. Specifically, we will use seed collected within the Potrero Preserve to seed plots in blocks A1, A2, A3, C1, B2, P1, and R1. Likewise, we will use seed collected from the San Martinez Grande Preserve in blocks F1, S1, and T1 (Figure 2).
3. **Topsoil will only be used in blocks far from occupied habitat:** To reduce the likelihood that spineflower seed in the salvaged seedbank topsoil from Mission Village development area will contaminate the spineflower populations within the Potrero Mesa and in San Martinez Grande, this treatment will only be conducted within blocks that are at least 1,000 feet away from spineflower occurrences (Figure 1). While this distance does not eliminate the possibility of cross pollination or seed dispersal, it reduces the likelihood of movement of genetic material to a very low level.
4. **The test plots with salvage seedbank topsoil are small**: The salvaged seedbank topsoil from the Spring, Airport and Magic Mountain areas will be spread in a total of just 22.5 m^2 (2 plots, each 2.25 m^2 in each of 5 blocks). The small area minimizes the likelihood that seed or pollen will be transported from the experimental plots to the native spineflower populations, which are

located more than 1,000 feet away.

Conservation Considerations

The CDFW 2081(a) application for plants states that sites chosen for reintroduction must have permanent protection in the event the reintroduction succeeds. While the purpose of the proposed study is not reintroduction, the study does include applying seed to unoccupied sites where spineflower could become established.

All of the experimental blocks as well as other candidate study sites evaluated for this study are located within areas that will be preserved as open areas as part of the Newhall Ranch Resource Management and Development Area (RMDP). The RMDP is a conservation, mitigation, and permitting plan for the long-term management of sensitive biological resources within the 11,999-acre Newhall Ranch Specific Plan (Specific Plan, located in unincorporated Los Angeles County, California (County of Los Angeles 2003). The RMDP and associated CDFW permit approvals incorporate an extensive conservation and resource management component, with all areas of the property outside of the development footprint required to be protected in perpetuity. The mechanism to protect these open space areas may take the form of Conservation Easements to the California Department of Fish and Wildlife or recorded restrictive covenants and deed restrictions, and other acceptable methods to ensure lands are held in a manner to preserve their function as natural open space, that are recorded at the time the adjacent areas are developed. These open space areas are also afforded endowment funding for their management, which will be established as development progresses.

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APPENDIX C

Preliminary Results of the 2016 San Fernando Valley Spineflower Seeding Study

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TECHNICAL MEMORANDUM

TO: Sam Rojas and Matt Carpenter, Director of Environmental Resources, FivePoint
FROM: Jodi McGraw, Ph.D., Ecologist and Principal, Jodi McGraw Consulting
DATE: April 29, 2017
SUBJECT: Preliminary Results of the 2016 San Fernando Valley Spineflower Seeding Study
CC: Andy Thomson, Dudek, and Nathan Gale and Anuja Parikh, FL*x*

Purpose

This memo summarizes preliminary results of the seeding study initiated in 2016, to examine seeding methods and habitat treatments designed to facilitate establishment of San Fernando Valley spineflower (*Chorizanthe parryi* var. *fernandina*). It is provided to FivePoint, Dudek, and Fl*x* to aid collective efforts to develop a plan for experimental introductions as conservation measures for the endangered plant.

Introduction

FivePoint (formerly The Newhall Land and Farming Company) prepared a Spineflower Conservation Plan (Plan), which describes the preservation, habitat management, and monitoring that will be conducted to mitigate the impacts of development as part of the Newhall Ranch Specific Plan on the San Fernando Valley spineflower (*Chorizanthe parryi* var. *fernandina*), a California endangered plant species (Dudek 2010). Developed in consultation with the California Department of Fish and Wildlife (the Department), the Plan calls for a habitat characterization of the San Fernando Valley spineflower (spineflower) to be conducted at the outset of Plan implementation, to increase understanding of the factors that influence the distribution, abundance, and individual and population performance of the spineflower in order to inform effective long-term management and monitoring.

In 2014, Jodi McGraw Consulting (JMc) initiated a study to characterize the habitat for spineflower by comparing a suite of abiotic and biotic conditions in 51 randomly located plots in areas occupied by spineflower to those in 51 randomly located plots located in areas of unoccupied habitat[1] (McGraw 2014). Within occupied plots, the study evaluated spineflower density and size, to assess factors that influence plant performance.

In 2016, Jodi McGraw Consulting partnered with Dudek, with support by Flx, to conduct a small-scale experimental study designed to test hypotheses for factors that influence spineflower demographic and

[1] Occupied areas were with the cumulative footprint of spineflower between 2002 and 2013 (Dudek 2013), and were occupied by spineflower spring 2014. Unoccupied areas were outside of the cumulative spineflower footprint and a buffer of 20 feet, but within mapped grassland or coastal scrub communities; they did not feature spineflower during spring 2014.

population performance, which were identified through the habitat characterization (McGraw and Thomson 2016). In addition to increasing understanding of spineflower ecology, this study was designed to inform a suite of conservation and management projects that FivePoint will implement as part of the Spineflower Conservation Plan (Dudek 2010) including the Spineflower Enhancement Program (Dudek 2014), which includes provisions for spineflower seeding trials using salvaged spineflower seed in new non-preserve areas.

Methods

As described in greater detail in the study proposal (McGraw and Thomson 2016), the study manipulated three factors that the habitat characterization identified as potentially influencing spineflower distribution, abundance, and individual plant growth and reproduction: soil compaction, exotic plant abundance, and soil moisture availability. These habitat treatments were implemented in a factorial design within 1.5 m × 1.5 m plots, to examine how the treatments independently and interactively influence spineflower establishment, survivorship, and reproduction (Figure 1).

To assess the relative effectiveness of different seeding methods, we compared broadcast seeding to translocating salvaged topsoil featuring spineflower seedbank in six of the 10 sites (Figure 2). This was done by establishing two plots with salvaged topsoil featuring spineflower seedbank: one was subjected to compaction, irrigation, and weeding, while the other served as a control (Figure 1).

To assess how variability in soil texture, chemistry, and plant community composition influences spineflower performance directly, and indirectly, via the habitat treatments, the experimental manipulations were conducted in 10 sites (Figure 2). These blocks were selected based on an analysis of multiple criteria for suitable habitat for spineflower identified through the habitat characterization (McGraw 2016, McGraw and Thomson 2016).

We examined the effects of seeding method, habitat treatments, and block conditions by measuring spineflower density and size in early February and again in mid-March 2017 within the 1 m^2 plot nested in the center of the treatment plot (to avoid edge effects). These measures of spineflower performance, which were measured along with conditions of the habitat (e.g., soil properties and plant species composition), will be evaluated along with measures of spineflower reproductive success (flower production and fruit production) in early June 2017.

Preliminary Results

The most recent census of the plots in late March 2017 revealed that spineflower successfully established from both broadcast seeding and salvaged seed topsoil in all ten test plot locations (blocks). Mean spineflower density was similar among broadcast seeded plots (mean = 7.4, SE = 0.89) and topsoil addition plots (mean = 9.3, SE = 2.0; Figure 3).

Mean spineflower density within plots significantly differed among blocks, and ranged between 1.4 and 12.6 plants per 1 m^2. There was no interaction effect between habitat treatments, seeding treatments, and block on spineflower density, suggesting that the general treatment effects described below were observed across the introduction sites, where variable abiotic and biotic habitat conditions may have influenced spineflower establishment and/or early survivorship.

Compaction of the soil prior to seeding significantly reduced spineflower density by 63%; uncompacted plots that were broadcast seeded averaged 11.4 spineflower (SE=1.5) while those that were compacted averaged just 4.2 (SE=0.7). A similar pattern was observed in comparing mean spineflower abundance in compacted and uncompacted topsoil plots (Figure 3), suggesting soil compaction may have reduced spineflower seedling establishment by inhibiting root penetration, and thus access to soil resources.

Controlling weeds using a weed whacker beginning in mid-February promoted spineflower survivorship between the census in early February and the most recent census in late March (Figure 4). This beneficial effect of weeding was only observed in uncompacted plots, where spineflower density was up an average of 32% (SE = 13.8) from February in weeded plots, but was down an average of 15% (SE = 16.1) in unweeded plots (Figure 4). This interaction effect, which may have resulted because weed cover and thus competition was lower in compacted plots, will be further evaluated as part of the study.

Due to the high rainfall in the 2017 growing season, the irrigation treatment was not initiated until mid-April; accordingly, there was no effect of irrigation on spineflower density measured in late March (Figure 3).

Next Steps

We will recensus the plots in early June to measure final spineflower density, size, flower production, and seed set. These and other spineflower performance variables will be analyzed to evaluate the independent and interactive effects of the habitat treatments and seeding treatments, and to further explore the role that varying abiotic and biotic conditions of habitat in the introduction sites may be playing in influencing spineflower performance. We also propose to monitor the plots again in 2018 to evaluate whether additional spineflower cohorts establish from dormant seed and/or seed produced in 2017.

The final results of the seeding study will be used to inform the design of future conservation and management measures for spineflower, including potential additional small-scale trials to evaluate additional treatments to promote spineflower population establishment during introductions.

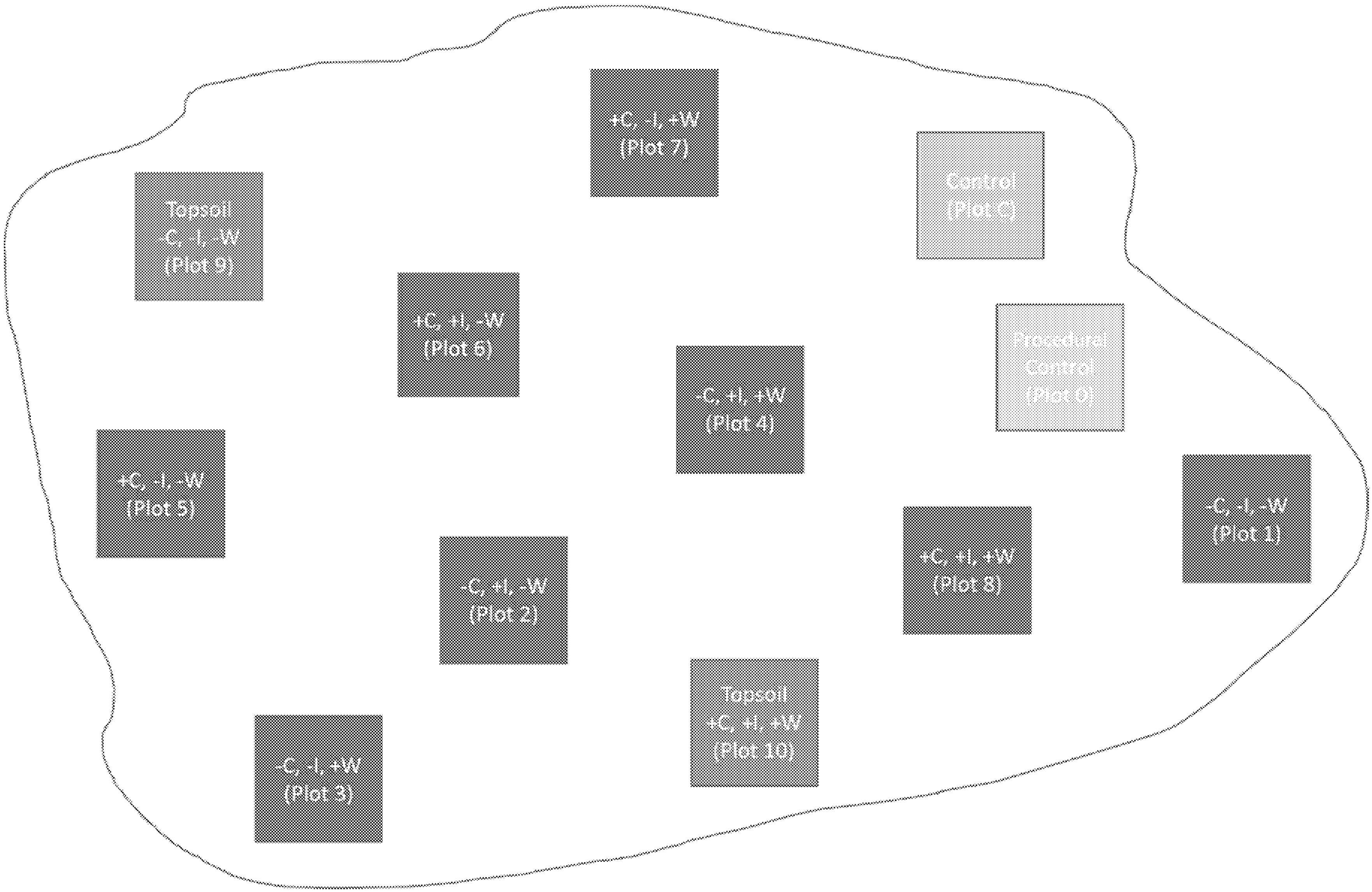

Figure 1: Experimental block design, showing plots that were broadcast seeded (green) and those that received salvaged seedbank topsoil (orange), and the following habitat treatments: soil compaction (+C), irrigation (+I) and weeding (+W). The six blocks located within 1,000 feet of existing spineflower only feature broadcast seeded plots (no salvaged seedbank topsoil; Plots 10 and 11).

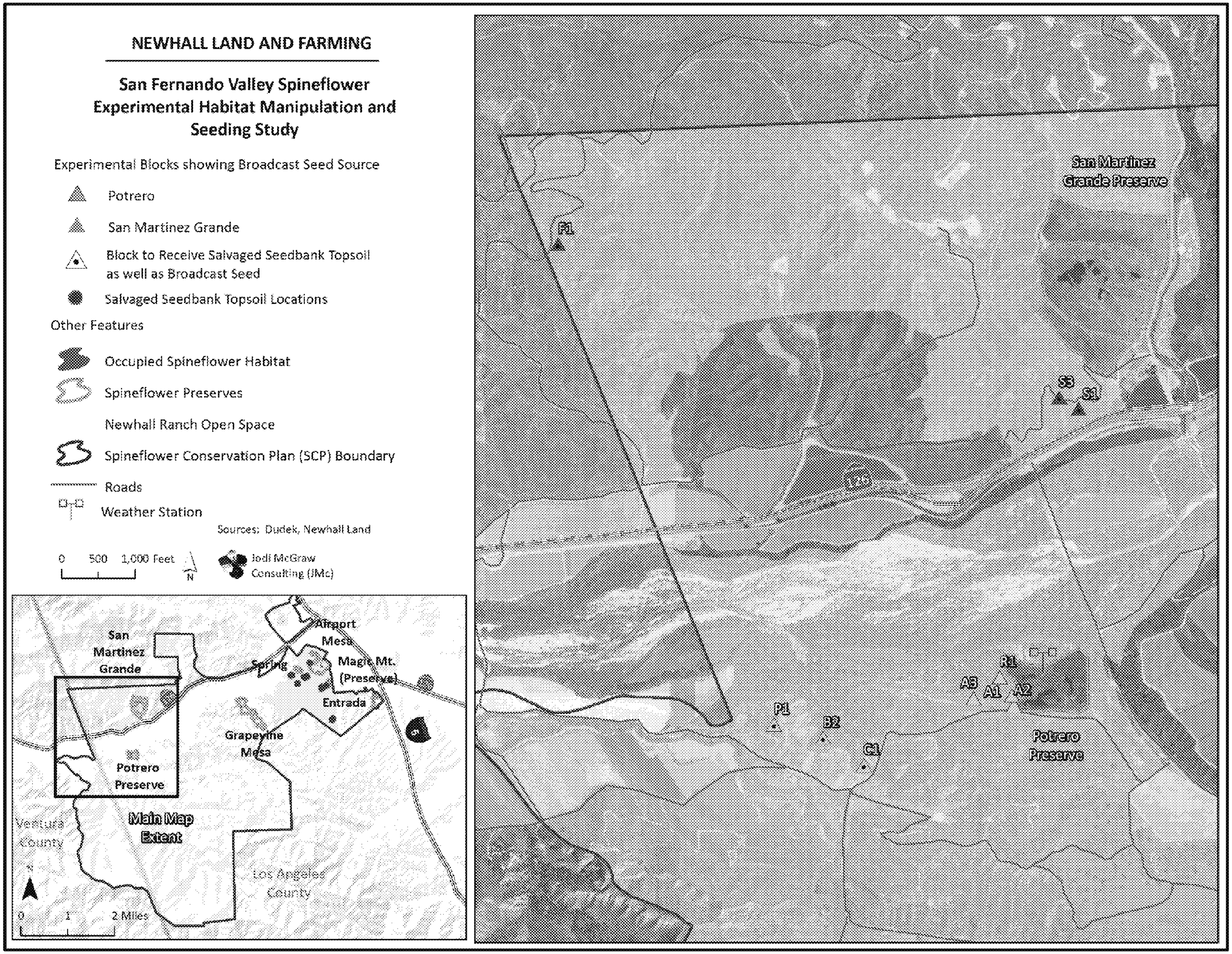

Figure 2: Experimental Habitat and Seeding Study Location

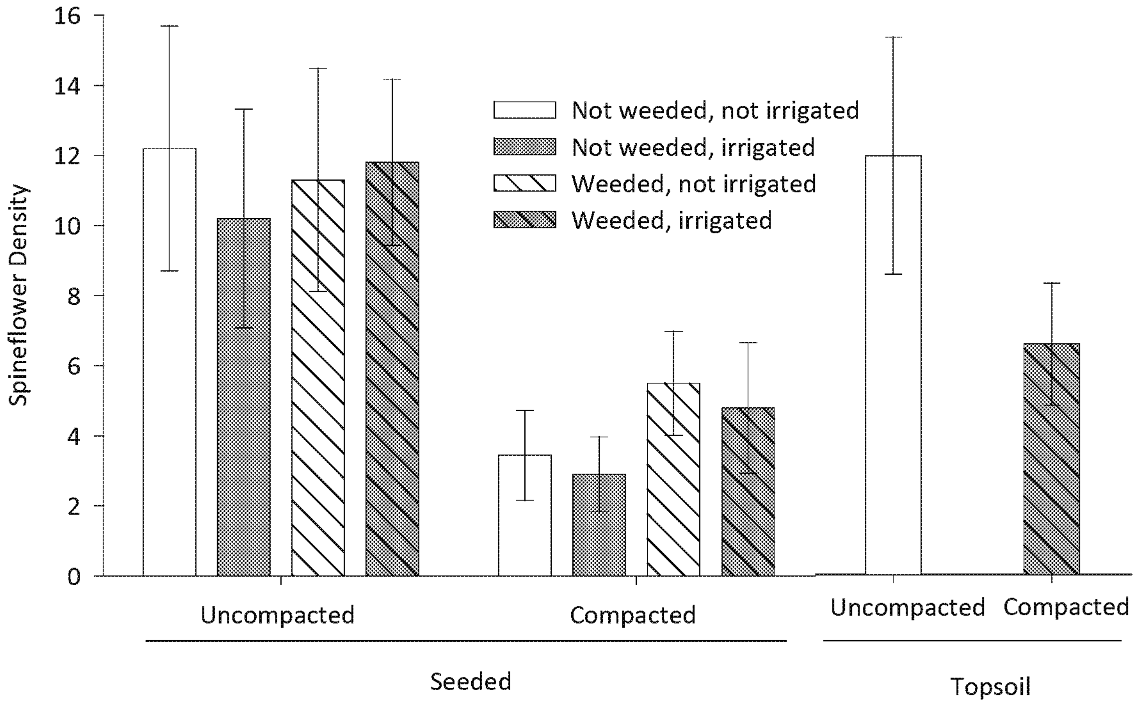

Figure 3: Spineflower density in seeding trial plots censused in late March 2017. Bars are mean densities per 1 m^2 ± 1 standard error.

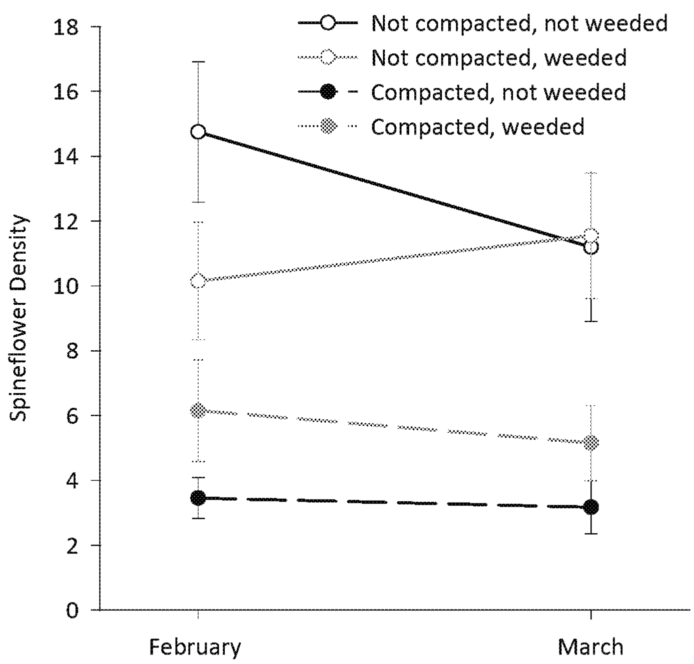

Figure 4: Spineflower density in broadcast seeded plots in early February and late March (values summed across irrigated plots). Points are mean densities per 1 m^2 ± 1 standard error.

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APPENDIX D

San Fernando Valley Spineflower Seed Collection Report

RANCHO SANTA ANA BOTANIC GARDEN

1500 North College Avenue, Claremont, CA 91711-3157 • Phone (909) 625-8767 • Fax (909) 626-7670
www.rsabg.org

4/8/15

Andy Thomson
Dudek
605 Third St.
Encinitas, CA 92024

Re: San Fernando Valley spineflower seed collection report

Dear Andy,

The cleaning and processing of San Fernando Valley spineflower (*Chorizanthe parryi* var. *fernandina*) has been completed. This report includes collection information, estimated seed quantities and germination results for each accession.

A total of eight accessions were deposited at Rancho Santa Ana Botanic Garden (RSABG) on September 17th, 2014. As requested, each accession had all or a portion of the total seeds placed into a temporary storage lot, which will be stored at RSABG until requested by Dudek for restoration/reintroduction use. Payment has been made for five years of temporary storage, if seed is requested after five years (after September 17th, 2019), an additional fee of $150 per year per accession will be required prior to release to Dudek. Seven of the accessions were also divided into permanent long term conservation seed collections. These collections are maintained under the ownership and authority of RSABG. For these collections, each accession is divided into three separate storage lots, with an active lot and base lot stored at RSABG, and a backup lot stored at the National Center for Genetic Resource Preservation in Fort Collins, CO. The active lot will be utilized for follow up germination testing and approved distribution, and the base and backup lots will be kept sealed for long term genetic preservation.

Overall, the seeds collections are robust, with high viability (Tables 1-9). The conservation collection meets RSABG targets for seed quantity and viability. The temporary collections range in size considerably. As we discussed, ex situ seed regeneration may be an option to consider for augmenting the temporary collections. RSABG has experience doing seed regeneration on this taxon, and could produce a large quantity of seeds without any additional take on extant populations.

Please let me know if any questions.

Sincerely,

Evan Meyer

California's Native Garden

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Taxon Information

Chorizanthe parryi var. *fernandina* (Polygonaceae)
San Fernando Valley spineflower
California Native Plant Society (CNPS): rare, threatened or endangered, 1B.1
California: Endangered, CE
Federal: Species of Concern, FC

Processing

Seed from each collection site was received in individual bags, and each collection was cleaned as a distinct accession to maintain specific site data. The cleaning of each lot included, but was not limited to the use of threshing over soil sieves, sorting based on density using a seed aspirator, and hand sorting. Non-viable seeds, along with chaff were removed from each seed lot during this process. An initial assessment of seed viability was based on seed dissection and presence of an embryo. This dissection showed great than 95% of seeds with an embryo that looked normal and viable during visual assessment. The chaff of each accession is stored at RSABG and likely contains a small percentage of viable seed. RSABG will distribute this to Dudek at no additional cost.

Packaging and Storage

To prepare the seed for long term storage, the seed moisture content was reduced by allowing the seed to equilibrate at 12-15% RH in an airtight drying chamber. Quantities for each seed lot were subsequently calculated based on the proportion of total weight to the weight of two hundred seeds which were counted by hand. The collections were split into four seed lots; an active research collection housed at RSABG, a base long term storage collection housed at RSABG, a backup collection sent to National Center for Genetic Resource Preservation in Fort Collins, CO, and the remaining held as a five year Temporary Research and Recovery Collection. Each accession was separated based on seed lot and the categories described above and packaged into heavy duty foil plastic laminate heat sealed storage pouches, labeled, and placed into RSABG freezers at -23°C.

Germination Tests

Germination tests were conducted to evaluate viability and germinability. Seeds were randomly selected from each accession and sown on a 0.5% agar solution on clear plastic examination plates. All seeds were soaked with a sterilizing bleach-tween solution for one minute to prevent mold contamination. A pretreatment of two week cold-moist stratification at 4°C was administered to each examination plate to induce germination. Following stratification, plates were placed in a germination chamber, maintained at 11 hours light cycle at 20° C and 13 hours dark cycle at 12° C. Seeds were monitored once a week, with each new germination being scored during monitoring. Protrusion of the radicle to at least one half the length of the seed was considered positive germination. Results for all tests (Table 9) indicate that a majority of seeds are viable and germination occurs within 1 week of stratification.

ED_013814_00001552-00152

Seed Collection Information

Accession: 24055

United States: California: Los Angeles County: Western Transverse Ranges: Newhall Ranch, Mission Village. Landowner: Newhall Land. GPS: N 34°25'18.837", W 118°36'37.79". Elevation: 1020 feet. Collectors: Andy Thomson, Kathleen Dayton, and David Zwick. August 7, 2014 & September 3, 2014 (Table 1).

Table 1. *Chorizanthe parryi* var. *fernandina* seeds collected at the Mission Village site stored in the RSABG seed house.

Collection Type	Lot #	Storage Type	Seed Quantity	# Plants Sampled
Temporary	5362	Bulk	73,947	12,000

Accession: 24051

United States: California: Los Angeles County: Western Transverse Ranges: Newhall Ranch, Airport Mesa Spineflower Preserve. Landowner: Newhall Land. GPS: N 34°25'40.781", W 118°36'23.571". Elevation: 1020 feet. Collectors: Andy Thomson, Kathleen Dayton, and David Zwick. August 25, 2014 & September 3, 2014 (Table 2).

Table 2. *Chorizanthe parryi* var. *fernandina* seeds collected at the Airport Mesa Spineflower Preserve stored in the RSABG seed house.

Collection Type	Lot #	Storage Type	Seed Quantity	# Plants Sampled
Active	5372	Bulk	3,500	14,050
Base	5372	Bulk	14,000	14,050
Backup	5372	Bulk	14,000	14,050
Temporary	5373	Bulk	491,897	14,050

Accession: 24052

United States: California: Los Angeles County: Western Transverse Ranges: Newhall Ranch, Entrada Spineflower Preserve. Landowner: Newhall Land. GPS: N 34°25'1.092", W 118°35'4.097". Elevation: 1170 feet. Collectors: Andy Thomson, Kathleen Dayton, and David Zwick. August 27, 2014 (Table 3).

Table 3. *Chorizanthe parryi* var. *fernandina* seeds collected at the Entrada Spineflower Preserve stored in the RSABG seed house.

Collection Type	Lot #	Storage Type	Seed Quantity	# Plants Sampled
Active	5374	Bulk	681	186
Base	5374	Bulk	1,600	186
Backup	5374	Bulk	2,271	186
Temporary	5375	Bulk	4,535	186

Accession: 24053

United States: California: Los Angeles County: Western Transverse Ranges: Newhall Ranch, Grapevine Mesa Spineflower Preserve. Landowner: Newhall Land. GPS: N 34°24'47.073", W 118°37'49.797". Elevation: 1060 feet. Collectors: Andy Thomson, Kathleen Dayton, and David Zwick. August 26, 2014 (Table 4).

Table 4. *Chorizanthe parryi* var. *fernandina* seeds collected at the Grapevine Mesa Spineflower Preserve stored in the RSABG seed house.

Collection Type	Lot #	Storage Type	Seed Quantity	# Plants Sampled
Active	5376	Bulk	3,000	2,300
Base	5376	Bulk	7,000	2,300
Backup	5376	Bulk	10,000	2,300
Temporary	5377	Bulk	52,133	2,300

Accession: 24054

United States: California: Los Angeles County: Western Transverse Ranges: Newhall Ranch, Magic Mountain Spineflower Preserve. Landowner: Newhall Land. GPS: N 34°25'24.005", W 118°36'8.272". Elevation: 1180 feet. Collectors: Andy Thomson, Kathleen Dayton, and David Zwick. August 28, 2014 (Table 5).

Table 5. *Chorizanthe parryi* var. *fernandina* seeds collected at the Magic Mountain Spineflower Preserve stored in the RSABG seed house.

Collection Type	Lot #	Storage Type	Seed Quantity	# Plants Sampled
Active	5378	Bulk	850	290
Base	5378	Bulk	1,044	290
Backup	5378	Bulk	1,991	290
Temporary	5379	Bulk	3,876	290

Accession: 24056

United States: California: Los Angeles County: Western Transverse Ranges: Newhall Ranch, Potrero Spineflower Preserve. Landowner: Newhall Land. GPS: N 34°24'1.73", W 118°40'31.245". Elevation: 1000 feet. Collectors: Andy Thomson, Kathleen Dayton, and David Zwick. August 26, 2014 (Table 6).

Table 6. *Chorizanthe parryi* var. *fernandina* seeds collected at the Potrero Spineflower Perserve stored in the RSABG seed house.

Collection Type	Lot #	Storage Type	Seed Quantity	# Plants Sampled
Active	5380	Bulk	3,002	600
Base	5380	Bulk	7,002	600
Backup	5380	Bulk	10,016	600
Temporary	5381	Bulk	39,972	600

Accession: 24057

United States: California: Los Angeles County: Western Transverse Ranges: Newhall Ranch, San Martinez Grande Spineflower Preserve. Landowner: Newhall Land. GPS: N 34°24'56.335", W 118°40'23.074". Elevation: 1040 feet. Collectors: Andy Thomson, Kathleen Dayton, and David Zwick. August 26, 2014 & August 27, 2014 (Table 7).

Table 7. *Chorizanthe parryi* var. *fernandina* seeds collected at the San Martinez Grande Spineflower Preserve stored in the RSABG seed house.

Collection Type	Lot #	Storage Type	Seed Quantity	# Plants Sampled
Active	5370	Bulk	3,006	11,850
Base	5370	Bulk	7,017	11,850
Backup	5370	Bulk	10,005	11,850
Temporary	5371	Bulk	190,689	11,850

Accession: 24058

United States: California: Los Angeles County: Western Transverse Ranges: Newhall Ranch, Spring Spineflower Preserve. Landowner: Newhall Land. GPS: N 34°25'38.402", W 118°36'49.97". Elevation: 1210 feet. Collectors: Andy Thomson, Kathleen Dayton, and David Zwick. August 28, 2014 (Table 8).

Table 8. *Chorizanthe parryi* var. *fernandina* seeds collected at the Spring Spineflower Preserve stored in the RSABG seed house.

Collection Type	Lot #	Storage Type	Seed Quantity	# Plants Sampled
Active	5382	Bulk	339	560
Base	5382	Bulk	770	560
Backup	5382	Bulk	1104	560
Temporary	5383	Bulk	2212	560

Germination Test Data

Table 9. *Chorizanthe parryi* var. *fernandina* germination tests conducted at RSABG growth chamber facilities.

Accession	Lot	# Tested	Start Date	End Date	# Germ	% Germ
24051	5372	78	1/28/2015	2/25/2015	68	87
24052	5374	46	1/28/2015	2/25/2015	36	78
24053	5376	60	1/28/2015	2/25/2015	55	92
24054	5378	50	1/28/2015	2/25/2015	42	84
24055	5362	79	1/28/2015	2/25/2015	63	79
24056	5380	50	1/28/2015	2/25/2015	49	98
24057	5370	60	1/28/2015	2/25/2015	58	97
24058	5382	50	1/28/2015	2/25/2015	40	80

Image: Storage Packaging

APPENDIX E

San Fernando Valley Spineflower Potential Off-Site Introduction/ Voucher Specimens Research

FL*x* MEMORANDUM

Date: April 25, 2017
To: Andy Thomson, DUDEK; Sam Rojas, Newhall; Jodi McGraw, JMc
From: Anuja Parikh, Nathan Gale, FL*x*
Subject: San Fernando Valley Spineflower Potential Offsite Introduction/Voucher Specimens Research
Attachments: Accompanying Photos (1-6)

The purpose of this memorandum is to report the results of our recent research regarding historic locations of occurrences of San Fernando Valley spineflower (*Chorizanthe parryi* var. *fernandina*). Following normal scientific protocol, botanists record these occurrences systematically by collecting and drying small samples of plant collections, which then are mounted on voucher specimen sheets and preserved in herbaria. The sheets also have labels that describe the plants, and record information about their associated species, habitats, and geographic locations. As is to be expected with historic collections, made during years when GPS technology was unavailable and accurate mapping was not possible, geographic locations were not recorded very precisely on these labels.

To support the efforts towards potential introduction of San Fernando Valley spineflower (*Chorizanthe parryi* var. *fernandina*), we researched herbarium records for historic occurrences of the species. Forty specimens were collected from the years 1879-1929 in Los Angeles and Orange counties; three more are not dated, but likely were collected during that time, based on the life span of those scientists. Six of these 43 specimens were collected from three preliminary offsite areas selected (and surveyed by us) for the potential introduction of this spineflower species: Castaic, Elizabeth Lake, and Chatsworth Park (see FL*x* memo dated February 23, 2017). After 1929, the species was not collected/documented until 1999 and later years.

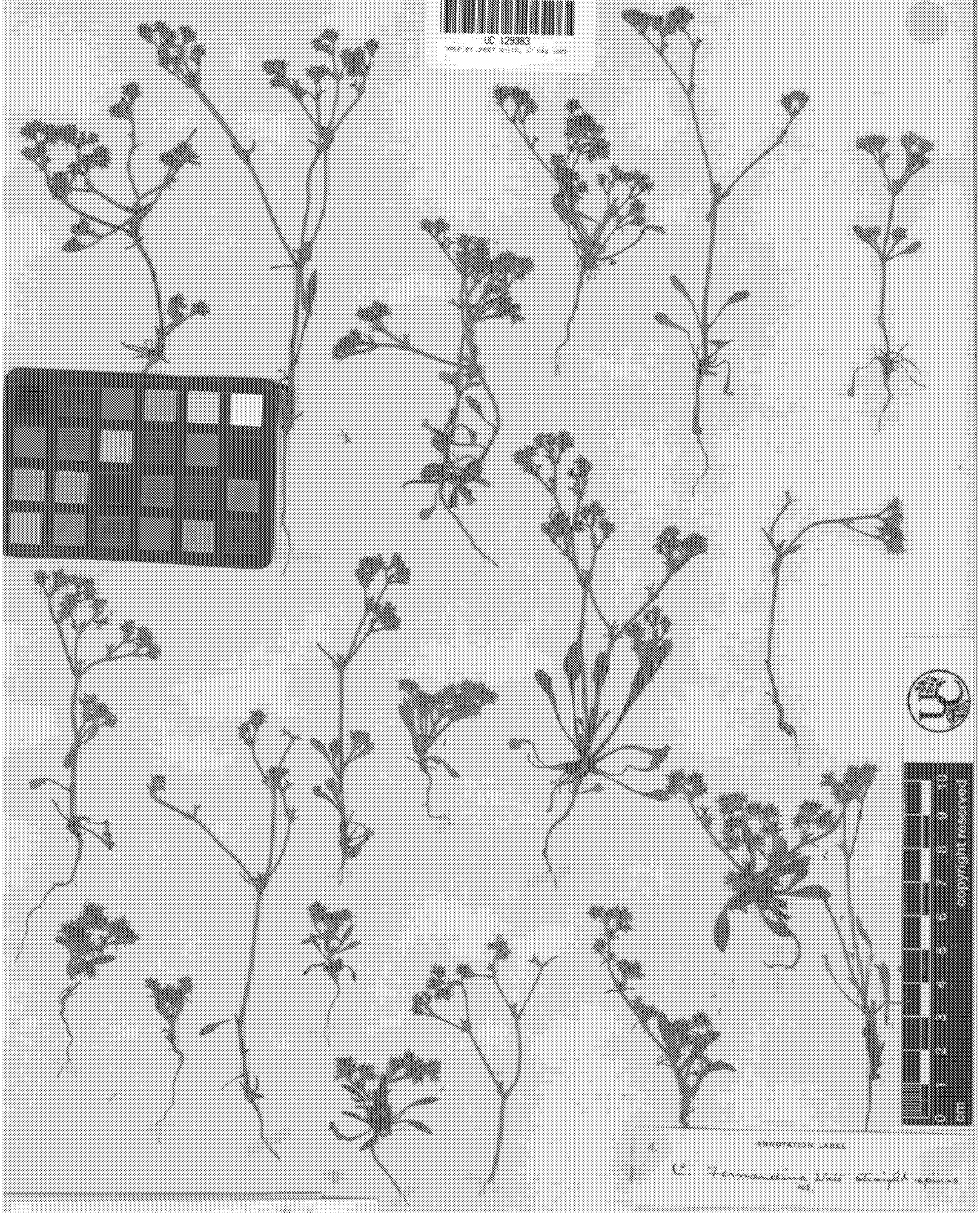
Of the six voucher specimens detailed in this memorandum, one is deposited at the University and Jepson Herbaria at UC Berkeley, one at the Rancho Santa Ana Botanic Garden and Pomona College combined herbaria, and four at the Santa Barbara Botanic Garden herbarium. The first two institutions have specimen imaging systems in place, and we requested permission from the collections managers to receive electronic downloads of images of the two voucher specimens (Photos 1, 2). Since the Santa Barbara Botanic Garden herbarium does not yet have an imaging system in place, we visited the herbarium and were permitted by the collections manager to photograph the four specimens deposited there (Photos 3, 4, 5, and 6).

More information about these specimens is included in the table below.

Photo	Specimen number	Collector	Date	Location
1	UC129383	H.M. Hall	no date	Vicinity of Elizabeth Lake
2	POM2186, RSA0100051	Le Roy Abrams	April 4, 1901	Chatsworth Park
3	SBBG62231	Ralph Hoffmann	July 9, 1928	Sandy bank, Elizabeth Lake
4	SBBG62232	Ralph Hoffmann	July 9, 1928	Sandy roadside, Elizabeth Lake
5	SBBG62229	Ralph Hoffmann	April 27, 1929	Sandy wash, near Castaic
6	SBBG62230	Ralph Hoffmann	May 21, 1929	Sandy bank, Elizabeth Lake

The identity of all these voucher specimens was confirmed in 1987 to be San Fernando Valley spineflower (*Chorizanthe parryi* var. *fernandina*) by the late Dr. James L. Reveal (the authority on the Eriogonoideae). We concur with this identification, but we note, however, that the voucher sheet collected by H. M. Hall appears to have specimens of this spineflower species, as well as specimens of the common species, pinyon spineflower (*Chorizanthe xanti* var. *xanti*), which we have observed recently in the Elizabeth Lake area.

UNIVERSITY HERBARIUM
University of California
Berkeley
UC 129383



4. ANNOTATION LABEL

C. fernandina Wats straight spines

Monographic Studies in Eriogonoideae

Chorizanthe parryi S. Wats.
var. *fernandiana* (S. Wats.) Jepson

James L. Reveal 1987
University of Maryland, College Park, MD 20742 – MARY

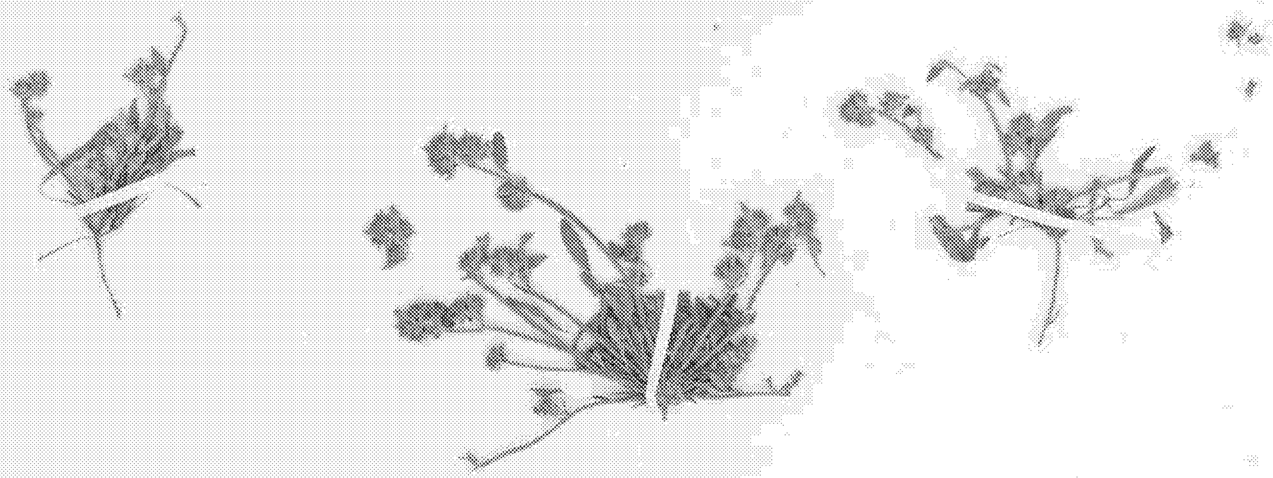
HERBARIUM OF THE UNIVERSITY OF CALIFORNIA
129383

PLANTS OF SOUTHERN CALIFORNIA
COLLECTED BY H. M. HALL, No. 729 b

Chorizanthe
Elizabeth Lake Los Angeles Co.
Vicinity of ~~[illegible]~~, in the Upper
Sonoran Zone, at feet altitude
white, outer lobes oval, inner narrow & ciliate

0 1 2 3 4 5 6 7 8 9 10
cm copyright reserved
BOTANIC GARDEN

RSA0100051



No. 1397
Chorizanthe parryi Wats. var. fernandina (Wats.) Jeps.
DETERMINATION BY [illegible] GEO. J. GOODMAN

FLORA OF CALIFORNIA.
LE ROY ABRAMS, COLLECTOR.

Chorizanthe fernandina [illegible]
Chatsworth Park [illegible]
No. 1397 DATE April [illegible]

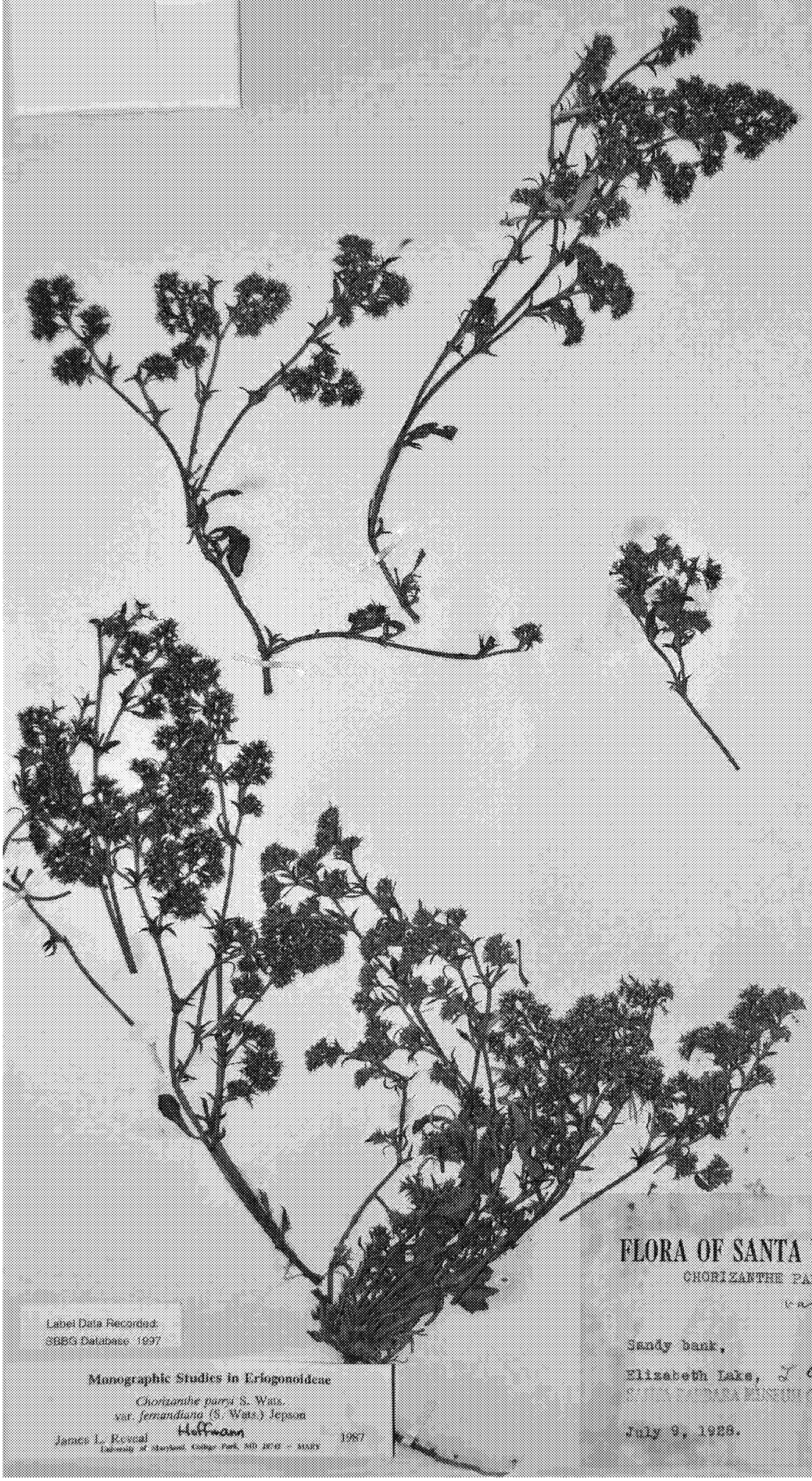
C. F. BAKER HERBARIUM
2186
POMONA COLLEGE

Specimen data entered into
RSA-POM Database

Monographic Studies in Eriogonoideae

Chorizanthe parryi S. Wats.
var. *fernandina* (S. Wats.) Jepson

James L. Reveal 1987
University of Maryland, College Park, MD [illegible] – MARY



5061

This SBM number superseded by SBBG number.

SANTA BARBARA BOTANIC GARDEN

062231

Label Data Recorded:
SBBG Database 1997

Monographic Studies in Eriogonoideae

Chorizanthe parryi S. Wats.
var. *fernandiana* (S. Wats.) Jepson

James L. Reveal   Hoffmann   1987
University of Maryland, College Park, MD 20742 – MARY

FLORA OF SANTA BARBARA REGION

CHORIZANTHE PARRYI, Wats.
var. fernandiana Jepson

Sandy bank,

Elizabeth Lake, L. A. Co.

July 9, 1928.

ED_013814_00001552-00165

5063

This SBM number
superseded by SBBG
number.

SANTA BARBARA BOTANIC GARDEN

062232

FLORA OF SANTA BARBARA REGION

CHORIZANTHE PARRYI, Wats. ?

var fernandina Jepson

Sandy roadside,
Elizabeth Lake. L. A. Co.

July 9, 1928.

Monographic Studies in Eriogonoideae

Chorizanthe parryi S. Wats.
var. *fernandiana* (S. Wats.) Jepson

James L. Reveal Hoffmann 1987
University of Maryland, College Park, MD 20742 - MARY

Label Data Recorded:
SBBG Database 1997

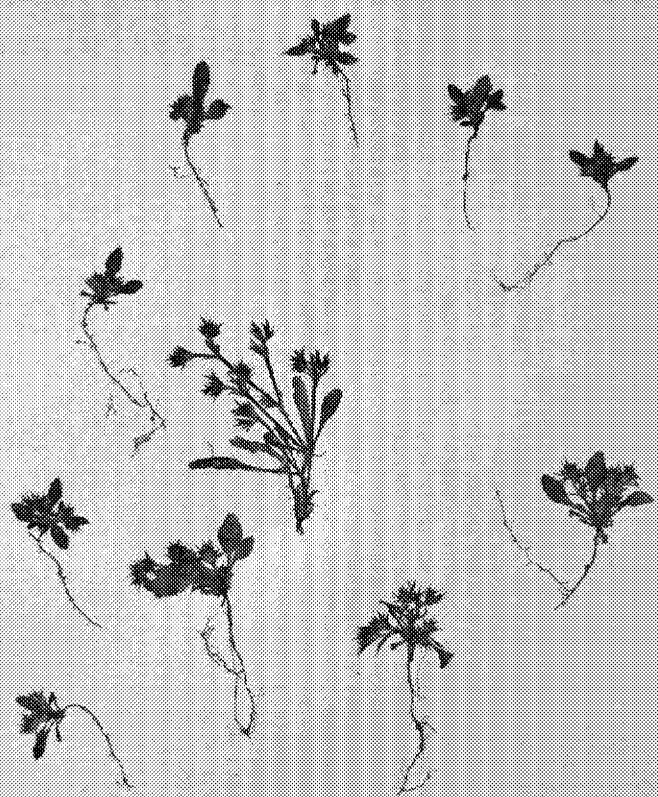
ED_013814_00001552-00167

7005

This SBM number superseded by SBBG number.

SANTA BARBARA · BOTANIC GARDEN

062229



Monographic Studies in Eriogonoideae

Chorizanthe parryi S. Wats.
var. *fernandiana* (S. Wats.) Jepson

James L. Reveal 1987
University of Maryland, College Park, MD 20742 – MARY

FLORA OF SANTA BARBARA REGION

CHORIZANTHE parryi Wats.
var. fernandiana Jepson

Sandy wash,
near Castaic, L. A. Co.

April 27, 1929. Ralph Hoffmann.

Label Data Recorded:
SBBG Database 1997

6299

This SBM number superseded by SBBG number.

SANTA BARBARA BOTANIC GARDEN

062230

FLORA OF SANTA BARBARA REGION

CHORIZANTHE PARRYI Wats.
Var. FERNANDINA Jepson.

Awns straight,
Stamens 9.

Sandy Bank,
Elizabeth Lake,
N. Los Angeles County.

May 21, 1929. Ralph Hoffmann.

Monographic Studies in Eriogonoideae

Chorizanthe parryi S. Wats.
var. *fernandina* (S. Wats.) Jepson

James L. Reveal 1987
University of Maryland, College Park, MD 20742 – MARY

Label Data Recorded
SBBG Database 1997

APPENDIX F

Evaluation of Prospective Introduction Sites for the San Fernando Valley Spineflower

Jodi McGraw Consulting
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PO Box 221 • Freedom, CA 95019
phone/fax: (831) 768-6988
jodi@jodimcgrawconsulting.com

TECHNICAL MEMORANDUM

TO: Sam Rojas and Matt Carpenter, Director of Environmental Resources, FivePoint
FROM: Jodi McGraw, Ph.D., Ecologist and Principal, Jodi McGraw Consulting
DATE: April 29, 2017
SUBJECT: Evaluation of Prospective Introduction Sites for the San Fernando Valley Spineflower
CC: Andy Thomson, Dudek, and Nathan Gale and Anuja Parikh, FL*x*

Purpose

This memo assesses the abiotic and biotic aspects of habitat within 72 areas selected by for evaluation of their suitability for introducing San Fernando Valley spineflower (*Chorizanthe parryi* var. *fernandina*). It is provided to FivePoint, Dudek, and FL*x* to aid collective efforts to develop a plan for experimental introductions to recover the endangered plant.

Introduction

FivePoint (formerly The Newhall Land and Farming Company) prepared a Spineflower Conservation Plan (Plan), which describes the preservation, habitat management, and monitoring that will be conducted to mitigate the impacts of development as part of the Newhall Ranch Specific Plan on the San Fernando Valley spineflower (*Chorizanthe parryi* var. *fernandina*), a California endangered plant species (Dudek 2010). Developed in consultation with the California Department of Fish and Wildlife (the Department), the Plan calls for a habitat characterization of the San Fernando Valley spineflower (spineflower) to be conducted at the outset of Plan implementation, to increase understanding of the factors that influence the distribution, abundance, and individual and population performance of the spineflower in order to inform effective long-term management and monitoring.

In 2014, Jodi McGraw Consulting (JMc) initiated a study to characterize the habitat for spineflower by comparing a suite of abiotic and biotic conditions in 51 randomly located plots in areas occupied by spineflower to those in 51 randomly located plots located in areas of unoccupied habitat[1] (McGraw 2014). Within occupied plots, the study evaluated spineflower density and size, to assess factors that influence plant performance.

The study used a nested sampling design to characterize habitat at two scales: habitat was evaluated in 5 m × 5 m plots, and microhabitat was assessed in 1 m × 1 m plots. Soil samples collected from the top

[1]Occupied areas were with the cumulative footprint of spineflower between 2002 and 2013 (Dudek 2013), and were occupied by spineflower spring 2014. Unoccupied areas were outside of the cumulative spineflower footprint and a buffer of 20 feet, but within mapped grassland or coastal scrub communities; they did not feature spineflower during spring 2014.

6" in the center of the nested study were analyzed by a soils laboratory which provided information about soil chemistry and texture.

The habitat characterization report (McGraw *in prep.*) will integrate results of the 2014 study with those of complementary studies that we conducted in 2013 (McGraw 2013) and 2015 (McGraw 2015). In these additional studies, we used a similar, comparative analysis to assess the spatial and temporal factors, including weather, that influence spineflower distribution, abundance, size, and reproduction.

To facilitate current efforts to identify potential sites in which spineflower could be introduced, I prepared a technical memorandum (McGraw 2016) addressing the following question*: What observable abiotic and biotic conditions are positively (or negatively) associated with spineflower occurrences in the Newhall Ranch Study Area, and can be used to select areas for quantitative evaluation of their suitability for potential experimental introductions of the species to expand its distribution and abundance?* These factors are summarized in Table 1; additional detail is provided in my prior memo (McGraw 2016).

In this memorandum, I present the results of initial data analyses conducted to aid efforts to assess the suitability of unoccupied habitat for introduction of spineflower, in order to expand the species distribution, population, and viability through experimental introduction. The assumption inherent in this approach is that introduced populations will have a greater probability of long-term viability, without interventions, in areas that feature a greater percentage of the abiotic and biotic habitat conditions associated with occupied habitat and that are known or hypothesized to influence the species' demographic performance.

Methods

The candidate introduction areas were identified by Dudek biologists, who used GIS to map areas that featured appropriate slope gradients (0–30 degrees) and slope aspects (120–240 degrees).
When sites were evaluated within or adjacent to the Newhall Ranch in 2016, the model also selected areas no greater than 1,500 feet above mean sea level (amsl), which corresponds generally to the maximum elevation of habitat currently occupied by spineflower (1,449 feet amsl). In 2017, when the analysis was broadened to include off-site areas in or near historic occurrences that are presumed to have been extirpated, elevation was dropped as a model criterion; instead, areas of suitable vegetation, slope gradient, and slope aspect were mapped within four candidate off-site areas identified below.

From these modeled suitable habitat areas, sites that were selected that were accessible from roads but located away from current and anticipated future development, where all else being equal, will have higher, long-term habitat suitability.

In early May 2016, Drs. Nathan Gale and Anuja Parikh of FL*x* examined the candidate areas within or near Newhall Ranch, to look for visual indicators of suitable spineflower habitat in three main geographic areas: the area west of Potrero Preserve (Area 1), the area west of San Martinez Grande Preserve (Area 2) within LA County, and the area west of San Martinez Grande (and Area 2) in Ventura County (Area 3; Table 1; McGraw 2016). In April 2017, FL*x* evaluated habitat within the four off-site areas: Castaic Mesa, Ventura Facing Simi, Elizabeth Lake, and Petersen Ranch. During the course of the two spring seasons, FL*x* delimited the boundaries of 69 areas totaling 71 acres which featured many if not all of the visual indicators for spineflower habitat (Table 1).

Table 1: Visual indicators of occupied spineflower habitat used to map suitable areas within the candidate introduction sites identified using GIS

Factor	Characteristic of Spineflower Habitat
Abiotic Factors	
Macrotopography	Benches, rounded ridgetops, or the upper third of hillslopes, which feature thinner and less developed soils, which reduce competition from dense herbs and shrubs.
Microtopography	Rounded or linear topography.
Slope Gradient	<32 degrees
Slope Aspect	120–240 degrees, where higher solar radiation limits dense growth of herbaceous plants and shrubs that can outcompete the diminutive herb.
Soil Texture	Soils with moderate silt (<70%), which similarly limit the density of more competitive plants.
Biotic Factors	
Litter and Woody Debris on the Soil Surface	Limited cover of litter or thatch (<30%) and woody debris (<10%) at the habitat level, and feature microhabitat areas that feature even less cover of such plant material (litter <10% and woody debris <3%), which likely inhibit spineflower establishment and also reflect dense growth by exotic grasses and native shrubs that compete with spineflower.
Disturbance	Recent or chronic disturbance, due to erosion, animal trails, or animal diggings, at least in a portion of the habitat area (>20%), to maintain areas of low litter and plant competition.
Shrub Cover	Sparse shrub cover (<20%).
Herbaceous Exotic Plant Cover	At the microhabitat scale, areas with low cover (<5%) of highly-competitive exotic annual grasses, including ripgut brome (*Bromus diandrus*), red brome (*Bromus madritensis* ssp. *rubens*), and slender oat (*Avena barbata*), which create dense litter and compete with spineflower for aboveground resources and light.
Herbaceous Annual Forb Cover	Relatively high diversity of other native annual forbs, including those species identified as positive indicator species (below).
Positive Indicator Species	Relatively high proportion of the following positive indicator species, which occur at high relative frequency and abundance in occupied habitat and therefore likely reflect suitable habitat conditions: • *Acmispon strigosus* • *Erodium cicutarium* • *Schismus barbatus* • *Trichostema lanceolatum* • *Pectocarya linearis* ssp. *ferocula* • *Eriogonum fasciculatum* var. *foliolosum* • *Eschscholzia californica* • *Lupinus bicolor.*

Table 1: Visual indicators of occupied spineflower habitat used to map suitable areas within the candidate introduction sites identified using GIS

Factor	Characteristic of Spineflower Habitat
Negative Indicator Species	Relatively low proportion of the following negative indicator species, which are positively associated with unoccupied habitat generally found on cooler, north-facing slopes and/or more developed soils, and therefore likely indicate areas that are not suitable for long-term persistence of the species: • *Artemisia californica* • *Salvia leucophylla* • *Bromus diandrus* • *Mirabilis laevis* var. *crassifolia*

To quantify habitat conditions within these sites, FL*x* collected abiotic and biotic data from seventy-two 5 m × 5 m plots, which were randomly located within a subset of the mapped polygons of potentially suitable habitat. To facilitate comparison of the site characteristics to those identified through the 2014 habitat characterization, FL*x* used the methods implemented in 2014 to collect abiotic and biotic data within each plot. To examine soil conditions, Andy Thomson of Dudek collected soil samples within each plot, which were analyzed for soil texture and chemistry following methods used to analyze soils in the 2014 habitat characterization.

I analyzed the data using a suite of descriptive statistical techniques designed to assess their similarity to the 51 occupied habitat sites analyzed in 2014. Specifically, 11 factors that I found to be associated with spineflower distribution and in some cases, also spineflower abundance, size, or reproduction. These include some of the 'visible' factors used to select sites (Table 1).

This initial analysis focused primarily on abiotic habitat conditions, though I also assessed native annual forb richness, which is positively associated with occupied spineflower habitat. Attempts to quantitatively compare plant cover in occupied sites sampled in 2014 and introduction sites sampled in 2016 and 2017 were confounded by the high interannual variability in rainfall: the much greater rainfall in 2016 and 2017 relative to 2014 increased herbaceous plant productivity and thus cover in the potential introduction sites relative to the reference sites. Efforts to 'control' the influence of rainfall on plant cover, including by comparing cover in occupied plots sampled in 2014, 2016, and 2017, could enable future comparisons of additional biotic indicators. While weather has some potential to also influence aspects of soil chemistry by, for example, affecting microbial activity, the abiotic indicators are assumed here to be comparable for purposes of this analysis.

I scored each factor in each plot, based on whether the value fell within the range of that variable that was observed in occupied habitat (score = 1) or whether it fell outside of the range (score = 0; Table 2). This approach was used to score all metrics with two exceptions:

1. **Elevation:** Plots within the elevation range of extant populations of spineflower (930–1,469 feet amsl) received a score of 1, while those outside of this range but within historic elevation range (i.e., including extirpated sites) of 0–4,139 feet amsl, were assigned a score of 0.5.
2. **Native Annual Forb Richness:** Plots were assigned a score of 1 if they had at least the minimum number of native annual forbs observed in the reference sites. The score was assigned to sites that exceeded the richness of native forbs measured in occupied habitat in Newhall Ranch in

2014 because 2017 was a much high precipitation year, which may have promoted native forb richness, and because native greater richness is likely not a negative factor for spineflower.

Results and Discussion

Table 2 lists the data collected for 72 sample sites for the 11 quantitative indicators of spineflower occupied habitat. As illustrated, the sample sites ranged between 5 and 11 indicators of occupied habitat each, and averaged 8.6 (SD = 1.2). Castaic Mesa, Petersen Ranch, and Ventura facing Simi all averaged above-average scores, as did Area 2 (west of San Martinez Grande within LA County), while Area 1 (west of Potrero) and Elizabeth Lake plots averaged below average values across the study: plots sampled in Area 3 (west of San Martinez Grande in Ventura County) averaged the global average. All sites featured slope and slope aspects that were within the range of those where spineflower has been observed, and all sites were within the species historic elevation range, with all sites except those in Ventura Facing Simi, Elizabeth Lake, and Petersen Ranch being within the species currently observed elevation range.

Plot scores varied within the general locations, however, particularly within Area 1 where plot scores ranged between 5 and 10, and in Castaic Mesa where plot scores ranged between 7 and 11. This range of plot scores within potential reintroduction sites primarily reflects their variability in soil conditions, which constitute 7 of the 11 metrics used to score suitability. Other sites featured more uniform scores, such as Petersen Ranch and Ventura Facing Simi, where scores among plots differed by only one or two points.

The factors examined here are positively associated with habitat occupied by spineflower. Several likely affect spineflower performance directly or indirectly, by affecting growth of spineflower competitors; however, others may simply be correlated (positively or negatively) with factors that are influential, and serve as indicators rather than causal determinants of suitable habitat.

Spineflower introductions should be designed and implemented as part of small-scale experiments to resolve questions about the role of habitat conditions in influencing spineflower demographic and population performance. During the 2016 seeding study, spineflower was introduced using broadcast seed and salvaged topsoil across a range of sites in Areas 1 and 2, which all met the known habitat requirements (e.g., slope aspect) but vary in conditions that could influence plant and population performance. By introducing spineflower across a range of conditions, we will be able to use the results of this study to assess the influence of these and other habitat factors on spineflower performance (McGraw and Thomson 2016). The study is similarly using habitat treatments (weeding, irrigation, and soil compaction) to examine their independent and interactive effects on spineflower performance during introductions (McGraw 2017).

Future experiments can build on the results of the 2016 seeding study and be used to evaluate the suitability of habitat in the four off-site locations. In doing so, they can test hypotheses generated by the habitat characterization study and help refine the spineflower ecological model in ways that can support conservation measures for the endangered plant. Conducting experimental introductions within the off-site areas can help evaluate the role of elevation and the associated temperature and precipitation gradients may play in influencing the performance of spineflower. Such information can greatly inform efforts to address spineflower persistence in a changing climate.

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Table 2: Number of habitat indicators for San Fernando Valley spineflower

		Slope (degrees)			Aspect (degrees)			Elevation (feet amsl)			Silt (%)			pH			Organic Matter (%)			Ammonium (ppm)			Soluble Potassium (meq/L)			Calcium (meq/L)			Manganese			Native Annual Forb Richness			
Values from Occupied Spineflower Sites (n=51)		Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	
		1-32	16.3	7.7	24-258	234	48	1,007-1,462	1,146	97.1	21-75.6	42.2	12.2	5.6-7.3	6.36	0.36	0.45-3.09	1.2	0.60	2.0-13.4	5.1	2.2	0.06-1.76	0.49	0.39	1.45-10.9	4.26	2.18	2.1-16.7	6.97	3.5	2-12	4.88	2.5	
Introduction Site	Year Evaluated	Value	in Range?	Score	Value	in Range?	Score	Value	in Range?[1]	Score	Value	in Range?	Score	Value	in Range?	Score	Value	in Range?	Score	Value	in Range?	Score	Value	in Range?	Score	Value	in Range?	Score	Value	in Range?	Score	Value	Meets Minimum[2]	Score	Total Score
1A1	2016	14	Y	1	153	Y	1	1,055	Y	1	86%	N	0	7.1	Y	1	4.5	N	0	3.2	Y	1	0.21	Y	1	6.7	Y	1	0.6	N	0	0	N	0	7
1A2	2016	11	Y	1	143	Y	1	1,023	Y	1	66%	Y	1	6.2	Y	1	3.9	N	0	2.8	Y	1	0.50	Y	1	3.1	Y	1	2.7	Y	1	2	Y	1	10
1A3	2016	6	Y	1	153	Y	1	1,051	Y	1	52%	Y	1	5.9	Y	1	3.3	N	0	1.8	N	0	0.81	Y	1	3.5	Y	1	3.2	Y	1	1	N	0	8
1B1	2016	21	Y	1	153	Y	1	1,048	Y	1	84%	N	0	6.8	Y	1	4.1	N	0	2.4	Y	1	0.26	Y	1	7.2	Y	1	1.0	N	0	0	N	0	7
1B2	2016	21	Y	1	173	Y	1	1,043	Y	1	90%	N	0	7.2	Y	1	4.4	N	0	3.3	Y	1	0.31	Y	1	6.7	Y	1	0.8	N	0	0	N	0	7
1C1	2016	17	Y	1	118	Y	1	1,049	Y	1	59%	Y	1	6.5	Y	1	3.1	Y	1	2.8	Y	1	0.45	Y	1	9.6	Y	1	2.2	Y	1	1	N	0	10
1D1	2016	25	Y	1	148	Y	1	955	Y	1	85%	N	0	7.3	Y	1	4.2	N	0	2.4	Y	1	0.26	Y	1	7.4	Y	1	0.8	N	0	0	N	0	7
1D2	2016	15	Y	1	163	Y	1	1,013	Y	1	82%	N	0	7.7	N	0	3.4	N	0	1.9	N	0	0.38	Y	1	6.9	Y	1	0.4	N	0	0	N	0	5
2E1	2016	20	Y	1	158	Y	1	1,516	Y[1]	0.5	83%	N	0	7.3	Y	1	5.6	N	0	2.3	Y	1	0.49	Y	1	6.0	Y	1	1.7	N	0	0	N	0	6.5
2F1	2016	14	Y	1	133	Y	1	1,368	Y	1	76%	Y	1	6.9	Y	1	3.6	N	0	3.2	Y	1	0.27	Y	1	3.3	Y	1	1.1	N	0	4	Y	1	9
2F2	2016	13	Y	1	148	Y	1	1,434	Y	1	69%	Y	1	7.0	Y	1	2.8	Y	1	2.0	Y	1	0.14	Y	1	2.9	Y	1	0.8	N	0	2	Y	1	10
3G1	2016	8	Y	1	178	Y	1	1,431	Y	1	83%	N	0	6.4	Y	1	4.1	N	0	2.9	Y	1	0.33	Y	1	3.0	Y	1	2.7	Y	1	0	N	0	8
3G2	2016	10	Y	1	203	Y	1	1,374	Y	1	68%	Y	1	6.4	Y	1	2.8	Y	1	2.6	Y	1	0.30	Y	1	2.1	Y	1	0.8	N	0	5	Y	1	10
3H1	2016	20	Y	1	143	Y	1	989	Y	1	89%	N	0	7.3	Y	1	3.7	N	0	1.7	N	0	0.42	Y	1	6.3	Y	1	0.9	N	0	2	Y	1	7
3H2	2016	19	Y	1	173	Y	1	1,033	Y	1	87%	N	0	7.5	N	0	3.4	N	0	3.8	Y	1	0.23	Y	1	6.9	Y	1	1.1	N	0	2	Y	1	7
3I1	2016	12	Y	1	178	Y	1	1,202	Y	1	61%	Y	1	6.5	Y	1	4.0	N	0	2.2	Y	1	0.24	Y	1	2.3	Y	1	1.4	N	0	4	Y	1	9
3I2	2016	13	Y	1	158	Y	1	1,133	Y	1	69%	Y	1	6.5	Y	1	4.5	N	0	3.3	Y	1	0.20	Y	1	2.0	Y	1	2.5	Y	1	3	Y	1	10
3J1	2016	22	Y	1	143	Y	1	1,274	Y	1	88%	N	0	7.2	Y	1	5.0	N	0	2.4	Y	1	0.46	Y	1	6.4	Y	1	0.7	N	0	2	Y	1	8
3J2	2016	22	Y	1	178	Y	1	1,202	Y	1	82%	N	0	7.3	Y	1	5.6	N	0	3.4	Y	1	0.35	Y	1	7.0	Y	1	0.8	N	0	1	N	0	7
3O1	2016	26	Y	1	145	Y	1	1,242	Y	1	74%	Y	1	6.5	Y	1	3.2	N	0	3.4	Y	1	1.63	Y	1	26.3	N	0	2.4	Y	1	1	N	0	8
1P1	2016	6	Y	1	150	Y	1	1,008	Y	1	74%	Y	1	6.4	Y	1	1.8	Y	1	3.5	Y	1	0.73	Y	1	5.2	Y	1	2.9	Y	1	1	N	0	10
1P2	2016	15	Y	1	140	Y	1	1,004	Y	1	81%	N	0	6.9	Y	1	2.1	Y	1	3.1	Y	1	0.45	Y	1	5.7	Y	1	1.6	N	0	0	N	0	8
1Q1	2016	24	Y	1	210	Y	1	1,054	Y	1	82%	N	0	7.1	Y	1	1.4	Y	1	2.8	Y	1	0.38	Y	1	4.9	Y	1	0.9	N	0	0	N	0	8
1R1	2016	13	Y	1	185	Y	1	1,020	Y	1	79%	N	0	6.0	Y	1	2.4	Y	1	4.9	Y	1	0.45	Y	1	3.3	Y	1	8.3	Y	1	1	N	0	9
2S1	2016	11	Y	1	190	Y	1	1,117	Y	1	75%	Y	1	6.1	Y	1	1.5	Y	1	3.5	Y	1	0.20	Y	1	4.6	Y	1	3.0	Y	1	0	N	0	10
2S2	2016	15	Y	1	135	Y	1	1,075	Y	1	69%	Y	1	6.9	Y	1	1.8	Y	1	3.4	Y	1	0.51	Y	1	6.4	Y	1	1.1	N	0	0	N	0	9
2S3	2016	22	Y	1	160	Y	1	974	Y	1	75%	Y	1	7.0	Y	1	1.9	Y	1	4.1	Y	1	0.19	Y	1	3.6	Y	1	0.8	N	0	1	N	0	9
2T1	2016	24	Y	1	135	Y	1	1,235	Y	1	77%	N	0	6.9	Y	1	2.2	Y	1	4.5	Y	1	0.53	Y	1	3.1	Y	1	1.3	N	0	0	N	0	8
2T2	2016	12	Y	1	135	Y	1	1,181	Y	1	73%	Y	1	6.4	Y	1	1.9	Y	1	3.1	Y	1	0.73	Y	1	3.5	Y	1	4.0	Y	1	1	N	0	10
3U1	2016	18	Y	1	140	Y	1	1,706	Y[1]	0.5	81%	N	0	6.3	Y	1	2.7	Y	1	7.3	Y	1	0.18	Y	1	2.2	Y	1	3.7	Y	1	4	Y	1	9.5
CM1-1	2017	12	Y	1	193	Y	1	1,409	Y	1	31%	Y	1	6.5	Y	1	2.4	Y	1	2.6	Y	1	0.06	Y	1	4.4	Y	1	2.0	N	0	9	Y	1	10
CM2-1	2017	3	Y	1	178	Y	1	1,407	Y	1	30%	Y	1	6.3	Y	1	2.3	Y	1	3.1	Y	1	0.08	Y	1	2.0	Y	1	2.8	Y	1	7	Y	1	11
CM2-2	2017	2	Y	1	183	Y	1	1,397	Y	1	46%	Y	1	6.2	Y	1	1.8	Y	1	1.2	N	0	0.26	Y	1	0.9	N	0	3.8	Y	1	9	Y	1	9
CM3-1	2017	2	Y	1	173	Y	1	1,361	Y	1	38%	Y	1	6.1	Y	1	1.9	Y	1	1.9	N	0	0.14	Y	1	1.6	Y	1	3.8	Y	1	10	Y	1	10
CM5-1	2017	1	Y	1	163	Y	1	1,137	Y	1	11%	N	0	6.5	Y	1	0.6	Y	1	0.9	N	0	0.07	Y	1	0.8	N	0	1.6	N	0	6	Y	1	7
CM6-1	2017	1	Y	1	163	Y	1	1,134	Y	1	17%	N	0	6.7	Y	1	1.2	Y	1	1.2	N	0	0.10	Y	1	1.4	N	0	2.2	Y	1	5	Y	1	8
CM7-1	2017	3	Y	1	183	Y	1	1,358	Y	1	32%	Y	1	6.2	Y	1	2.4	Y	1	1.8	N	0	0.06	Y	1	0.9	N	0	4.9	Y	1	7	Y	1	9
CM7-2	2017	8	Y	1	173	Y	1	1,338	Y	1	39%	Y	1	5.7	Y	1	2.1	Y	1	2.7	Y	1	0.14	Y	1	0.9	N	0	7.0	Y	1	11	Y	1	10
CM8-1	2017	2	Y	1	198	Y	1	1,288	Y	1	31%	Y	1	6.2	Y	1	1.5	Y	1	1.3	N	0	0.19	Y	1	1.7	Y	1	2.5	Y	1	10	Y	1	10
CM8-2	2017	12	Y	1	173	Y	1	1,273	Y	1	32%	Y	1	6.7	Y	1	1.7	Y	1	1.3	N	0	0.06	Y	1	1.1	N	0	2.1	Y	1	10	Y	1	9
CM9-1	2017	5	Y	1	113	Y	1	1,239	Y	1	35%	Y	1	6.2	Y	1	1.9	Y	1	1.2	N	0	0.33	Y	1	0.8	N	0	4.6	Y	1	13	Y	1	9
CM10-1	2017	1	Y	1	183	Y	1	1,215	Y	1	40%	Y	1	6.2	Y	1	2.0	Y	1	1.3	N	0	0.22	Y	1	1.2	N	0	3.8	Y	1	13	Y	1	9
CM10-2	2017	11	Y	1	183	Y	1	1,273	Y	1	34%	Y	1	6.4	Y	1	2.2	Y	1	1.4	N	0	0.07	Y	1	3.3	Y	1	1.7	N	0	9	Y	1	9

Table 2: Number of habitat indicators for San Fernando Valley spineflower (cont.)

		Slope (degrees)			Aspect (degrees)			Elevation (feet amsl)			Silt (%)			pH			Organic Matter (%)			Ammonium (ppm)			Soluble Potassium (meq/L)			Calcium (meq/L)			Manganese			Native Annual Forb Richness			
Values from Occupied Spineflower Sites (n=51)		Range 1-32	Mean 16.3	SD 7.7	Range 24-258	Mean 234	SD 48	Range 1,007-1,462	Mean 1,146	SD 97.1	Range 21-75.6	Mean 42.2	SD 12.2	Range 5.6-7.3	Mean 6.36	SD 0.36	Range 0.45-3.09	Mean 1.2	SD 0.60	Range 2.0-13.4	Mean 5.1	SD 2.2	Range 0.06-1.76	Mean 0.49	SD 0.39	Range 1.45-10.9	Mean 4.26	SD 2.18	Range 2.1-16.7	Mean 6.97	SD 3.5	Range 2-12	Mean 4.88	SD 2.5	
Introduction Site	Year Evaluated	Value	in Range?	Score	Value	in Range?	Score	Value	in Range?[1]	Score	Value	in Range?	Score	Value	in Range?	Score	Value	in Range?	Score	Value	in Range?	Score	Value	in Range?	Score	Value	in Range?	Score	Value	in Range?	Score	Value	Meets Minimum [2]	Score	Total Score
EL2-1	2017	8	Y	1	163	Y	1	3,316	Y[1]	0.5	12%	N	0	6.6	Y	1	0.9	Y	1	1.2	N	0	0.21	Y	1	0.9	N	0	2.9	Y	1	15	Y	1	7.5
EL4-1	2017	8	Y	1	163	Y	1	3,353	Y[1]	0.5	9%	N	0	5.7	Y	1	1.3	Y	1	1.6	N	0	0.16	Y	1	1.4	N	0	11.8	Y	1	14	Y	1	7.5
EL5-1	2017	6	Y	1	158	Y	1	3,364	Y[1]	0.5	6%	N	0	6.2	Y	1	1.0	Y	1	1.2	N	0	0.17	Y	1	0.9	N	0	4.2	Y	1	8	Y	1	7.5
EL6-1	2017	5	Y	1	163	Y	1	3,349	Y[1]	0.5	7%	N	0	5.9	Y	1	1.1	Y	1	1.0	N	0	0.34	Y	1	0.8	N	0	3.6	Y	1	10	Y	1	7.5
EL7-1	2017	8	Y	1	163	Y	1	3,363	Y[1]	0.5	8%	N	0	6.2	Y	1	0.9	Y	1	1.2	N	0	0.11	Y	1	0.9	N	0	3.7	Y	1	22	Y	1	7.5
EL8-1	2017	5	Y	1	163	Y	1	3,308	Y[1]	0.5	11%	N	0	5.9	Y	1	1.1	Y	1	1.0	N	0	0.17	Y	1	0.8	N	0	5.3	Y	1	13	Y	1	7.5
EL9-1	2017	1	Y	1	193	Y	1	3,374	Y[1]	0.5	54%	Y	1	5.8	Y	1	3.9	N	0	3.2	Y	1	1.22	Y	1	3.4	Y	1	6.0	Y	1	6	Y	1	9.5
EL10-1	2017	17	Y	1	148	Y	1	3,405	Y[1]	0.5	10%	N	0	6.2	Y	1	1.3	Y	1	1.2	N	0	0.12	Y	1	0.8	N	0	2.4	Y	1	8	Y	1	7.5
EL11-1	2017	23	Y	1	188	Y	1	3,440	Y[1]	0.5	11%	N	0	6.6	Y	1	1.9	Y	1	0.8	N	0	0.05	N	0	1.1	N	0	3.0	Y	1	12	Y	1	6.5
PR 15-1-1	2017	19	Y	1	188	Y	1	3,410	Y[1]	0.5	23%	Y	1	5.8	Y	1	2.0	Y	1	2.3	Y	1	0.74	Y	1	3.6	Y	1	8.2	Y	1	5	Y	1	10.5
PR 15-2-1	2017	21	Y	1	188	Y	1	3,374	Y[1]	0.5	22%	Y	1	6.2	Y	1	1.3	Y	1	1.9	N	0	0.26	Y	1	2.7	Y	1	5.5	Y	1	6	Y	1	9.5
PR 15-4-1	2017	11	Y	1	123	Y	1	3,454	Y[1]	0.5	19%	N	0	5.9	Y	1	1.1	Y	1	1.6	N	0	0.29	Y	1	1.6	Y	1	4.7	Y	1	10	Y	1	8.5
PR 15-4-2	2017	6	Y	1	148	Y	1	3,511	Y[1]	0.5	36%	Y	1	5.8	Y	1	1.3	Y	1	1.8	N	0	0.32	Y	1	7.2	Y	1	4.3	Y	1	5	Y	1	9.5
PR 16-3-1	2017	16	Y	1	178	Y	1	3,563	Y[1]	0.5	20%	N	0	7.2	Y	1	1.2	Y	1	1.8	N	0	0.12	Y	1	3.2	Y	1	3.2	Y	1	8	Y	1	8.5
PR 16-8-1	2017	14	Y	1	193	Y	1	3,553	Y[1]	0.5	20%	N	0	6.7	Y	1	1.2	Y	1	1.4	N	0	0.10	Y	1	3.9	Y	1	4.1	Y	1	12	Y	1	8.5
PR 20-7-1	2017	12	Y	1	188	Y	1	3,576	Y[1]	0.5	17%	N	0	6.9	Y	1	1.0	Y	1	1.7	N	0	0.10	Y	1	2.3	Y	1	5.3	Y	1	8	Y	1	8.5
PR 20-11-1	2017	6	Y	1	153	Y	1	3,683	Y[1]	0.5	24%	Y	1	6.4	Y	1	1.4	Y	1	1.9	N	0	0.22	Y	1	4.7	Y	1	4.4	Y	1	2	Y	1	9.5
PR 20-16-1	2017	20	Y	1	163	Y	1	3,666	Y[1]	0.5	17%	N	0	6.6	Y	1	1.0	Y	1	1.5	N	0	0.10	Y	1	2.1	Y	1	7.2	Y	1	6	Y	1	8.5
PR 20-19-1	2017	2	Y	1	203	Y	1	3,616	Y[1]	0.5	20%	N	0	6.3	Y	1	0.9	Y	1	1.5	N	0	0.22	Y	1	4.0	Y	1	3.9	Y	1	3	Y	1	8.5
VS1-1	2017	9	Y	1	153	Y	1	2,609	Y[1]	0.5	59%	Y	1	6.1	Y	1	4.6	N	0	5.2	Y	1	2.10	N	0	3.7	Y	1	4.9	Y	1	2	Y	1	8.5
VS2-1	2017	6	Y	1	183	Y	1	2,628	Y[1]	0.5	62%	Y	1	5.8	Y	1	5.7	N	0	3.9	Y	1	0.92	Y	1	3.4	Y	1	2.6	Y	1	4	Y	1	9.5
VS3-1	2017	12	Y	1	188	Y	1	2,731	Y[1]	0.5	65%	Y	1	7.3	Y	1	5.0	N	0	3.4	Y	1	0.16	Y	1	4.8	Y	1	0.9	N	0	4	Y	1	8.5
VS3-2	2017	20	Y	1	218	Y	1	2,779	Y[1]	0.5	55%	Y	1	6.3	Y	1	6.2	N	0	3.8	Y	1	0.19	Y	1	3.1	Y	1	1.5	N	0	3	Y	1	8.5
VS4-1	2017	16	Y	1	203	Y	1	2,864	Y[1]	0.5	62%	Y	1	6.9	Y	1	8.0	N	0	2.7	Y	1	0.12	Y	1	3.7	Y	1	1.4	N	0	2	Y	1	8.5
VS5-1	2017	17	Y	1	183	Y	1	2,902	Y[1]	0.5	55%	Y	1	7.5	N	0	7.3	N	0	2.4	Y	1	0.40	Y	1	6.2	Y	1	2.8	Y	1	2	Y	1	8.5
VS6-1	2017	15	Y	1	153	Y	1	2,883	Y[1]	0.5	54%	Y	1	7.3	Y	1	5.9	N	0	2.5	Y	1	0.09	Y	1	5.7	Y	1	0.9	N	0	2	Y	1	8.5
VS6-2	2017	14	Y	1	203	Y	1	2,920	Y[1]	0.5	65%	Y	1	6.3	Y	1	6.9	N	0	5.2	Y	1	0.10	Y	1	3.7	Y	1	3.5	Y	1	4	Y	1	9.5
VS6-3	2017	11	Y	1	213	Y	1	3,016	Y[1]	0.5	67%	Y	1	6.3	Y	1	6.7	N	0	4.4	Y	1	0.33	Y	1	2.5	Y	1	2.8	Y	1	7	Y	1	9.5
VS6-4	2017	11	Y	1	173	Y	1	3,000	Y[1]	0.5	63%	Y	1	6.9	Y	1	9.5	N	0	3.0	Y	1	0.20	Y	1	4.2	Y	1	2.9	Y	1	5	Y	1	9.5

[1] Plots within the elevation range of extant populations of spineflower (930-1,469 ft amsl) received a score of 1, while those outside of this range but within historic elevation range (i.e., including extirpated sites) of 0 - 4,139 ft amsl, were assigned a score of 0.5.

[2] Plots were assigned a score of 1 if they had at least the minimum number of native annual forbs observed in the reference sites.

APPENDIX G

Data Collection Form for Evaluation of Potential Introduction Sites

Potential Introduction Sites for San Fernando Valley Spineflower Recovery Plan
Observers: Anuja Parikh, Nathan Gale, FL*x* **Date: ________________**

Area: ___ Location: ____ Site: ___ Plot: ___ Aspect: _____ Slope (deg.): _____
Macrotopo: _________________ Microtopo: _________________ Notes: ____

Variable	Sampling Area (5m x 5m)	Larger Study Area (Visual Assessment of General Conditions)
Photo # (up./lo. corners, center, general)		
Disturbance: (%) / Type		
(Disturbance Type: A = animal digging/burrows; T = trails; S = slides/erosion; G = grading (or other mechanical); F = farming/agricultural use)		
Disturbance comments		
Total vegetation cover: (%)		
Bare: (%)		
Litter (leaves, thatch): (%) / Type		
Woody debris: (%) / Type		
Shrub cover: (%) Total/Live/Dead		
Forb cover: (%)		
Grass cover: (%)		
Species Cover: (%)		
(Species Cover: 5% between 10% and 90%, with <1%, 1%, 3%, 5%, 8%, 93%, 97%, and 99%)		
Acm stri		
Ero cic		
Sch bar		
Tric lan		
Pec lin fer		
Eri fas fol		
Esc cal		
Lup bic		
Cen mel		
Las cal		
Log fil		
Cha gla		
Sal tra		

Potential Introduction Sites for San Fernando Valley Spineflower Recovery Plan

Observers: Anuja Parikh, Nathan Gale, FL*x* **Date: ________________**

Variable	Sampling Area (5m x 5m)	Larger Study Area (Visual Assessment of General Conditions)

APPENDIX H

Soil Test Results (2016 and 2017)

ANALYTICAL CHEMISTS
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SOIL CONTROL LAB

42 HANGAR WAY
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TEL: 831-724-5422
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Work Order #: 6050350
Account #: 8350
Date Received: May 11, 2016
Date Reported: May 13, 2016

Soil Report

Jodi McGraw Consulting
P.O. Box 221
Freedom, CA 95019
Attn: Jodi McGraw

Lab Number: 6050350-1/20
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: A-0

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	4.6	10-50	Low
Nitrate (NO_3-N)	17	20-100	Low
Total Available N	21	75-150	Low
Phosphorous(P_2O_5)	82	100-300	Low
Potassium (K_2O)	220	450-750	Low
Calcium (Ca)	4300	3412-4265	High
Magnesium (Mg)	760	341-682	High
Sulfate (SO_4-S)	30	100-200	Low
Sodium (Na)	37	< 250	See SAR
Chloride (Cl)	18	1-100	OK
ECe (dS/m)	0.45	0.2-4	OK
Copper (Cu)	0.73	1 +	Low
Zinc (Zn)	0.65	3 +	Low
Iron (Fe)	11	8 +	OK
Manganese (Mn)	3.0	4 +	Low
Boron (B)	0.36	1-4	Low
SAR	0.42	0-6	OK
CEC (meq/100gms)	14	10-20	OK
ESP (%)	0.57	0-10	OK
pHs Value	6.5	6.5-7.5	OK
Organic Matter (%)	2.8		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
200	Phosphorous (P_2O_5)
350	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep
needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.5

Gypsum Requirement (needed for clay treatment)
2.3 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	8.4	mg/Kg	KCl
NH_3-N	2.3	mg/Kg	KCl
P	19	mg/Kg	Olsen
SP	54	%	Sat
pHs	6.5	unit	Sat
ECe	0.45	dS/m	Sat
Ca	2.8	meq/L	Sat
Mg	1.5	meq/L	Sat
Na	0.63	meq/L	Sat
K	0.22	meq/L	Sat
Cl	0.46	meq/L	Sat
SO_4-S	0.86	meq/L	Sat
SAR	0.42	ratio	Calc
B	0.18	mg/Kg	CaCl2
Cu	0.36	mg/Kg	DTPA
Zn	0.33	mg/Kg	DTPA
Fe	5.3	mg/Kg	DTPA
Mn	1.5	mg/Kg	DTPA

Data:			Method
OrgMat	2.8	%	WalkBk
Org-C	1.6	%	WalkBk
SMP Bufffer pH	7.20	unit	SMP
GypReq	2.7	meq/100g	GypSol
Ca	2100	mg/Kg	NH_4OAc
Mg	380	mg/Kg	NH_4OAc
Na	19	mg/Kg	NH_4OAc
K	92	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	14	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	75.3	% of CEC	Calc.
Mg	22.3	% of CEC	Calc.
Na	0.6	% of CEC	Calc.
K	1.7	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

ANALYTICAL CHEMISTS
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SOIL CONTROL LAB

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Account #: 8350
Date Received: May 11, 2016
Date Reported: May 13, 2016

Soil Report

Jodi McGraw Consulting
P.O. Box 221
Freedom, CA 95019
Attn: Jodi McGraw

Lab Number: 6050350-2/20
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: A-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	6.4	10-50	Low
Nitrate (NO_3-N)	6.2	20-100	Low
Total Available N	13	75-150	Low
Phosphorous(P_2O_5)	65	100-300	Low
Potassium (K_2O)	300	476-794	Low
Calcium (Ca)	6100	4062-5078	High
Magnesium (Mg)	280	406-812	Low
Sulfate (SO_4-S)	28	100-200	Low
Sodium (Na)	32	< 250	See SAR
Chloride (Cl)	31	1-100	OK
ECe (dS/m)	0.75	0.2-4	OK
Copper (Cu)	0.53	1 +	Low
Zinc (Zn)	0.41	3 +	Low
Iron (Fe)	7.0	8 +	Low
Manganese (Mn)	1.2	4 +	Low
Boron (B)	0.95	1-4	Low
SAR	0.32	0-6	OK
CEC (meq/100gms)	17	10-20	OK
ESP (%)	0.41	0-10	OK
pHs Value	7.1	6.5-7.5	OK
Organic Matter (%)	4.5		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
200	Phosphorous (P_2O_5)
300	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.0

Gypsum Requirement (needed for clay treatment)
1.0 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	3.1	mg/Kg	KCl
NH_3-N	3.2	mg/Kg	KCl
P	15	mg/Kg	Olsen
SP	60	%	Sat
pHs	7.1	unit	Sat
ECe	0.75	dS/m	Sat
Ca	6.7	meq/L	Sat
Mg	0.82	meq/L	Sat
Na	0.63	meq/L	Sat
K	0.21	meq/L	Sat
Cl	0.73	meq/L	Sat
SO_4-S	0.72	meq/L	Sat
SAR	0.32	ratio	Calc
B	0.48	mg/Kg	CaCl2
Cu	0.27	mg/Kg	DTPA
Zn	0.21	mg/Kg	DTPA
Fe	3.5	mg/Kg	DTPA
Mn	0.58	mg/Kg	DTPA

Data:			Method
OrgMat	4.5	%	WalkBk
Org-C	2.6	%	WalkBk
SMP Bufffer pH	7.40	unit	SMP
GypReq	1.1	meq/100g	GypSol
Ca	3100	mg/Kg	NH_4OAc
Mg	140	mg/Kg	NH_4OAc
Na	16	mg/Kg	NH_4OAc
K	130	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	17	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	90.6	% of CEC	Calc.
Mg	7.0	% of CEC	Calc.
Na	0.4	% of CEC	Calc.
K	1.9	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

ANALYTICAL CHEMISTS and BACTERIOLOGISTS Approved by State of California

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Account #: 8350
Date Received: May 11, 2016
Date Reported: May 13, 2016

Soil Report

Jodi McGraw Consulting
P.O. Box 221
Freedom, CA 95019
Attn: Jodi McGraw

Lab Number: 6050350-3/20
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: A-2

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	5.5	10-50	Low
Nitrate (NO_3-N)	11	20-100	Low
Total Available N	17	75-150	Low
Phosphorous(P_2O_5)	100	100-300	OK
Potassium (K_2O)	460	450-750	OK
Calcium (Ca)	3100	2744-3430	OK
Magnesium (Mg)	710	300-600	High
Sulfate (SO_4-S)	30	100-200	Low
Sodium (Na)	35	< 250	See SAR
Chloride (Cl)	40	1-100	OK
ECe (dS/m)	0.54	0.2-4	OK
Copper (Cu)	0.88	1 +	Low
Zinc (Zn)	0.78	3 +	Low
Iron (Fe)	29	8 +	OK
Manganese (Mn)	5.4	4 +	OK
Boron (B)	0.39	1-4	Low
SAR	0.44	0-6	OK
CEC (meq/100gms)	11	10-20	OK
ESP (%)	0.66	0-10	OK
pHs Value	6.2	6.5-7.5	Low
Organic Matter (%)	3.9		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
150	Phosphorous (P_2O_5)
100	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
2000	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.3
pH 7.0 needs	0.8

Gypsum Requirement (needed for clay treatment)
2.1 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	5.6	mg/Kg	KCl
NH_3-N	2.8	mg/Kg	KCl
P	23	mg/Kg	Olsen
SP	54	%	Sat
pHs	6.2	unit	Sat
ECe	0.54	dS/m	Sat
Ca	3.1	meq/L	Sat
Mg	2.0	meq/L	Sat
Na	0.69	meq/L	Sat
K	0.50	meq/L	Sat
Cl	1.1	meq/L	Sat
SO_4-S	0.88	meq/L	Sat
SAR	0.44	ratio	Calc
B	0.19	mg/Kg	CaCl2
Cu	0.44	mg/Kg	DTPA
Zn	0.39	mg/Kg	DTPA
Fe	14	mg/Kg	DTPA
Mn	2.7	mg/Kg	DTPA

Data:			Method
OrgMat	3.9	%	WalkBk
Org-C	2.3	%	WalkBk
SMP Bufffer pH	7.03	unit	SMP
GypReq	2.5	meq/100g	GypSol
Ca	1600	mg/Kg	NH_4OAc
Mg	360	mg/Kg	NH_4OAc
Na	17	mg/Kg	NH_4OAc
K	190	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	11	meq/100gm	Calc.
NH_3-N	0.2	% of CEC	Calc.
Ca	68.8	% of CEC	Calc.
Mg	26.0	% of CEC	Calc.
Na	0.7	% of CEC	Calc.
K	4.3	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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Account #: 8350
Date Received: May 11, 2016
Date Reported: May 13, 2016

Soil Report

Jodi McGraw Consulting
P.O. Box 221
Freedom, CA 95019
Attn: Jodi McGraw

Lab Number: 6050350-4/20
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: A-3

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	3.7	10-50	Low
Nitrate (NO_3-N)	15	20-100	Low
Total Available N	19	75-150	Low
Phosphorous(P_2O_5)	150	100-300	OK
Potassium (K_2O)	480	450-750	OK
Calcium (Ca)	2300	2000-2500	OK
Magnesium (Mg)	390	300-600	OK
Sulfate (SO_4-S)	28	100-200	Low
Sodium (Na)	28	< 250	See SAR
Chloride (Cl)	72	1-100	OK
ECe (dS/m)	0.62	0.2-4	OK
Copper (Cu)	0.81	1 +	Low
Zinc (Zn)	1.0	3 +	Low
Iron (Fe)	45	8 +	OK
Manganese (Mn)	6.4	4 +	OK
Boron (B)	0.36	1-4	Low
SAR	0.52	0-6	OK
CEC (meq/100gms)	7.9	10-20	OK
ESP (%)	0.77	0-10	OK
pHs Value	5.9	6.5-7.5	Low
Organic Matter (%)	3.3		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
100	Phosphorous (P_2O_5)
100	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
2000	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.1
pH 6.5 needs	0.6
pH 7.0 needs	1.1

Gypsum Requirement (needed for clay treatment)
2.0 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	7.7	mg/Kg	KCl
NH_3-N	1.8	mg/Kg	KCl
P	34	mg/Kg	Olsen
SP	45	%	Sat
pHs	5.9	unit	Sat
ECe	0.62	dS/m	Sat
Ca	3.5	meq/L	Sat
Mg	1.8	meq/L	Sat
Na	0.85	meq/L	Sat
K	0.81	meq/L	Sat
Cl	2.3	meq/L	Sat
SO_4-S	0.97	meq/L	Sat
SAR	0.52	ratio	Calc
B	0.18	mg/Kg	CaCl2
Cu	0.40	mg/Kg	DTPA
Zn	0.51	mg/Kg	DTPA
Fe	22	mg/Kg	DTPA
Mn	3.2	mg/Kg	DTPA

Data:			Method
OrgMat	3.3	%	WalkBk
Org-C	1.9	%	WalkBk
SMP Bufffer pH	7.03	unit	SMP
GypReq	2.3	meq/100g	GypSol
Ca	1100	mg/Kg	NH_4OAc
Mg	190	mg/Kg	NH_4OAc
Na	14	mg/Kg	NH_4OAc
K	200	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	7.9	meq/100gm	Calc.
NH_3-N	0.2	% of CEC	Calc.
Ca	72.2	% of CEC	Calc.
Mg	20.4	% of CEC	Calc.
Na	0.8	% of CEC	Calc.
K	6.4	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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Soil Report

Jodi McGraw Consulting
P.O. Box 221
Freedom, CA 95019
Attn: Jodi McGraw

Lab Number: 6050350-5/20
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: B-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	4.8	10-50	Low
Nitrate (NO_3-N)	35	20-100	OK
Total Available N	40	75-150	Low
Phosphorous(P_2O_5)	100	100-300	OK
Potassium (K_2O)	250	450-750	Low
Calcium (Ca)	4300	2947-3684	High
Magnesium (Mg)	280	300-600	Low
Sulfate (SO_4-S)	73	100-200	Low
Sodium (Na)	32	< 250	See SAR
Chloride (Cl)	73	1-100	OK
ECe (dS/m)	0.90	0.2-4	OK
Copper (Cu)	0.98	1 +	Low
Zinc (Zn)	0.38	3 +	Low
Iron (Fe)	9.6	8 +	OK
Manganese (Mn)	1.9	4 +	Low
Boron (B)	0.51	1-4	Low
SAR	0.40	0-6	OK
CEC (meq/100gms)	12	10-20	OK
ESP (%)	0.56	0-10	OK
pHs Value	6.8	6.5-7.5	OK
Organic Matter (%)	4.1		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

100	Nitrogen (N)
150	Phosphorous (P_2O_5)
300	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.2

Gypsum Requirement (needed for clay treatment)
1.1 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	17	mg/Kg	KCl
NH_3-N	2.4	mg/Kg	KCl
P	24	mg/Kg	Olsen
SP	62	%	Sat
pHs	6.8	unit	Sat
ECe	0.90	dS/m	Sat
Ca	7.2	meq/L	Sat
Mg	1.2	meq/L	Sat
Na	0.83	meq/L	Sat
K	0.26	meq/L	Sat
Cl	1.7	meq/L	Sat
SO_4-S	1.8	meq/L	Sat
SAR	0.40	ratio	Calc
B	0.25	mg/Kg	CaCl2
Cu	0.49	mg/Kg	DTPA
Zn	0.19	mg/Kg	DTPA
Fe	4.8	mg/Kg	DTPA
Mn	0.97	mg/Kg	DTPA

Data:			Method
OrgMat	4.1	%	WalkBk
Org-C	2.4	%	WalkBk
SMP Bufffer pH	7.35	unit	SMP
GypReq	1.2	meq/100g	GypSol
Ca	2200	mg/Kg	NH_4OAc
Mg	140	mg/Kg	NH_4OAc
Na	16	mg/Kg	NH_4OAc
K	100	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	12	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	87.6	% of CEC	Calc.
Mg	9.5	% of CEC	Calc.
Na	0.6	% of CEC	Calc.
K	2.2	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

42 HANGAR WAY
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Work Order #: 6050350
Account #: 8350
Date Received: May 11, 2016
Date Reported: May 13, 2016

Soil Report

Jodi McGraw Consulting
P.O. Box 221
Freedom, CA 95019
Attn: Jodi McGraw

Lab Number: 6050350-6/20
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: B-2

	Your Values (lbs/acre 6" deep)	Suggested Values
Ammonia (NH_3-N)	6.6	10-50 Low
Nitrate (NO_3-N)	29	20-100 OK
Total Available N	35	75-150 Low
Phosphorous(P_2O_5)	120	100-300 OK
Potassium (K_2O)	350	450-750 Low
Calcium (Ca)	5600	3705-4631 High
Magnesium (Mg)	260	370-741 Low
Sulfate (SO_4-S)	30	100-200 Low
Sodium (Na)	25	< 250 See SAR
Chloride (Cl)	36	1-100 OK
ECe (dS/m)	0.80	0.2-4 OK
Copper (Cu)	0.84	1 + Low
Zinc (Zn)	0.66	3 + Low
Iron (Fe)	8.9	8 + OK
Manganese (Mn)	1.7	4 + Low
Boron (B)	0.88	1-4 Low
SAR	0.30	0-6 OK
CEC (meq/100gms)	15	10-20 OK
ESP (%)	0.36	0-10 OK
pHs Value	7.2	6.5-7.5 OK
Organic Matter (%)	4.4	

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

100	Nitrogen (N)
150	Phosphorous (P_2O_5)
250	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.0

Gypsum Requirement (needed for clay treatment)
0.9 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	14	mg/Kg	KCl
NH_3-N	3.3	mg/Kg	KCl
P	26	mg/Kg	Olsen
SP	59	%	Sat
pHs	7.2	unit	Sat
ECe	0.80	dS/m	Sat
Ca	6.7	meq/L	Sat
Mg	0.78	meq/L	Sat
Na	0.58	meq/L	Sat
K	0.31	meq/L	Sat
Cl	0.86	meq/L	Sat
SO_4-S	0.79	meq/L	Sat
SAR	0.30	ratio	Calc
B	0.44	mg/Kg	CaCl2
Cu	0.42	mg/Kg	DTPA
Zn	0.33	mg/Kg	DTPA
Fe	4.5	mg/Kg	DTPA
Mn	0.83	mg/Kg	DTPA

Data:			Method
OrgMat	4.4	%	WalkBk
Org-C	2.6	%	WalkBk
SMP Bufffer pH	7.42	unit	SMP
GypReq	1.1	meq/100g	GypSol
Ca	2800	mg/Kg	NH_4OAc
Mg	130	mg/Kg	NH_4OAc
Na	13	mg/Kg	NH_4OAc
K	150	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	15	meq/100gm	Calc.
NH_3-N	0.2	% of CEC	Calc.
Ca	90.1	% of CEC	Calc.
Mg	6.9	% of CEC	Calc.
Na	0.4	% of CEC	Calc.
K	2.4	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

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Date Received: May 11, 2016
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Soil Report

Jodi McGraw Consulting
P.O. Box 221
Freedom, CA 95019
Attn: Jodi McGraw

Lab Number: 6050350-7/20
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: C-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	5.6	10-50	Low
Nitrate (NO_3-N)	65	20-100	OK
Total Available N	71	75-150	Low
Phosphorous(P_2O_5)	120	100-300	OK
Potassium (K_2O)	270	450-750	Low
Calcium (Ca)	3000	2194-2742	High
Magnesium (Mg)	300	300-600	OK
Sulfate (SO_4-S)	120	100-200	OK
Sodium (Na)	23	< 250	See SAR
Chloride (Cl)	55	1-100	OK
ECe (dS/m)	1.3	0.2-4	OK
Copper (Cu)	0.81	1 +	Low
Zinc (Zn)	0.58	3 +	Low
Iron (Fe)	21	8 +	OK
Manganese (Mn)	4.4	4 +	OK
Boron (B)	0.40	1-4	Low
SAR	0.35	0-6	OK
CEC (meq/100gms)	9.1	10-20	OK
ESP (%)	0.56	0-10	OK
pHs Value	6.5	6.5-7.5	OK
Organic Matter (%)	3.1		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

75	Nitrogen (N)
150	Phosphorous (P_2O_5)
300	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.6

Gypsum Requirement (needed for clay treatment)
1.1 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	32	mg/Kg	KCl
NH_3-N	2.8	mg/Kg	KCl
P	28	mg/Kg	Olsen
SP	53	%	Sat
pHs	6.5	unit	Sat
ECe	1.3	dS/m	Sat
Ca	9.6	meq/L	Sat
Mg	2.3	meq/L	Sat
Na	0.84	meq/L	Sat
K	0.45	meq/L	Sat
Cl	1.5	meq/L	Sat
SO_4-S	3.5	meq/L	Sat
SAR	0.35	ratio	Calc
B	0.20	mg/Kg	CaCl2
Cu	0.40	mg/Kg	DTPA
Zn	0.29	mg/Kg	DTPA
Fe	11	mg/Kg	DTPA
Mn	2.2	mg/Kg	DTPA

Data:			Method
OrgMat	3.1	%	WalkBk
Org-C	1.8	%	WalkBk
SMP Bufffer pH	7.30	unit	SMP
GypReq	1.3	meq/100g	GypSol
Ca	1500	mg/Kg	NH_4OAc
Mg	150	mg/Kg	NH_4OAc
Na	12	mg/Kg	NH_4OAc
K	110	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	9.1	meq/100gm	Calc.
NH_3-N	0.2	% of CEC	Calc.
Ca	82.6	% of CEC	Calc.
Mg	13.5	% of CEC	Calc.
Na	0.6	% of CEC	Calc.
K	3.1	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

42 HANGAR WAY WATSONVILLE CALIFORNIA 95076 USA

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Date Received: May 11, 2016
Date Reported: May 13, 2016

Soil Report

Jodi McGraw Consulting
P.O. Box 221
Freedom, CA 95019
Attn: Jodi McGraw

Lab Number: 6050350-8/20
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: D-1

	Your Values (lbs/acre 6" deep)	Suggested Values
Ammonia (NH_3-N)	4.9	10-50 Low
Nitrate (NO_3-N)	53	20-100 OK
Total Available N	58	75-150 Low
Phosphorous(P_2O_5)	45	100-300 Low
Potassium (K_2O)	290	450-750 Low
Calcium (Ca)	5300	3510-4388 High
Magnesium (Mg)	240	351-702 Low
Sulfate (SO_4-S)	49	100-200 Low
Sodium (Na)	30	< 250 See SAR
Chloride (Cl)	39	1-100 OK
ECe (dS/m)	0.94	0.2-4 OK
Copper (Cu)	0.77	1 + Low
Zinc (Zn)	0.27	3 + Low
Iron (Fe)	6.2	8 + Low
Manganese (Mn)	1.5	4 + Low
Boron (B)	1.0	1-4 OK
SAR	0.32	0-6 OK
CEC (meq/100gms)	15	10-20 OK
ESP (%)	0.44	0-10 OK
pHs Value	7.3	6.5-7.5 OK
Organic Matter (%)	4.2	

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

75	Nitrogen (N)
250	Phosphorous (P_2O_5)
300	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.0

Gypsum Requirement (needed for clay treatment)
0.7 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	26	mg/Kg	KCl
NH_3-N	2.4	mg/Kg	KCl
P	10	mg/Kg	Olsen
SP	68	%	Sat
pHs	7.3	unit	Sat
ECe	0.94	dS/m	Sat
Ca	7.4	meq/L	Sat
Mg	0.91	meq/L	Sat
Na	0.66	meq/L	Sat
K	0.26	meq/L	Sat
Cl	0.81	meq/L	Sat
SO_4-S	1.1	meq/L	Sat
SAR	0.32	ratio	Calc
B	0.52	mg/Kg	CaCl2
Cu	0.38	mg/Kg	DTPA
Zn	0.13	mg/Kg	DTPA
Fe	3.1	mg/Kg	DTPA
Mn	0.76	mg/Kg	DTPA

Data:			Method
OrgMat	4.2	%	WalkBk
Org-C	2.5	%	WalkBk
SMP Bufffer pH	7.48	unit	SMP
GypReq	0.81	meq/100g	GypSol
Ca	2600	mg/Kg	NH_4OAc
Mg	120	mg/Kg	NH_4OAc
Na	15	mg/Kg	NH_4OAc
K	120	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	15	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	90.3	% of CEC	Calc.
Mg	7.0	% of CEC	Calc.
Na	0.4	% of CEC	Calc.
K	2.1	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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Work Order #: 6050350
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Date Received: May 11, 2016
Date Reported: May 13, 2016

Soil Report

Jodi McGraw Consulting
P.O. Box 221
Freedom, CA 95019
Attn: Jodi McGraw

Lab Number: 6050350-9/20
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: D-2

	Your Values (lbs/acre 6" deep)	Suggested Values	RECOMMENDATIONS ALL VALUES lbs/acre 6" deep
Ammonia (NH_3-N)	3.8	10-50 Low	125 Nitrogen (N)
Nitrate (NO_3-N)	< 4	20-100 Low	200 Phosphorous (P_2O_5)
Total Available N	7.6	75-150 Low	350 Potassium (K_2O)
Phosphorous(P_2O_5)	78	100-300 Low	0 Gypsum ($CaSO_4$)
Potassium (K_2O)	200	450-750 Low	0 Lime ($CaCO_3$)
Calcium (Ca)	4500	2975-3719 High	0 Dolomite ($CaCO_3$ & $MgCO_3$)
Magnesium (Mg)	180	300-600 Low	0 Sulfur
Sulfate (SO_4-S)	22	100-200 Low	*Gypsum adds Ca and doesn't affect pH; Lime adds Ca
Sodium (Na)	31	< 250 See SAR	and raises pH; Dolomite adds Ca & Mg & raises pH.
Chloride (Cl)	24	1-100 OK	
ECe (dS/m)	0.49	0.2-4 OK	Lime Requirement:
Copper (Cu)	0.80	1 + Low	Tons of 100% $CaCO_3$ Lime per Acre 6" deep
Zinc (Zn)	0.23	3 + Low	needed to raise pH of soil to:
Iron (Fe)	6.5	8 + Low	
Manganese (Mn)	0.84	4 + Low	pH 6.0 needs 0.0
Boron (B)	0.87	1-4 Low	pH 6.5 needs 0.0
SAR	0.38	0-6 OK	pH 7.0 needs 0.0
CEC (meq/100gms)	12	10-20 OK	
ESP (%)	0.54	0-10 OK	Gypsum Requirement (needed for clay treatment)
pHs Value	7.7	6.5-7.5 High	0.6 tons per acre 6" deep
Organic Matter (%)	3.4		Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	< 2	mg/Kg	KCl
NH_3-N	1.9	mg/Kg	KCl
P	18	mg/Kg	Olsen
SP	65	%	Sat
pHs	7.7	unit	Sat
ECe	0.49	dS/m	Sat
Ca	6.9	meq/L	Sat
Mg	1.1	meq/L	Sat
Na	0.76	meq/L	Sat
K	0.38	meq/L	Sat
Cl	0.53	meq/L	Sat
SO_4-S	0.53	meq/L	Sat
SAR	0.38	ratio	Calc
B	0.44	mg/Kg	CaCl2
Cu	0.40	mg/Kg	DTPA
Zn	0.11	mg/Kg	DTPA
Fe	3.3	mg/Kg	DTPA
Mn	0.42	mg/Kg	DTPA

Data:			Method
OrgMat	3.4	%	WalkBk
Org-C	2.0	%	WalkBk
SMP Bufffer pH	7.53	unit	SMP
GypReq	0.70	meq/100g	GypSol
Ca	2300	mg/Kg	NH_4OAc
Mg	91	mg/Kg	NH_4OAc
Na	15	mg/Kg	NH_4OAc
K	84	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	12	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	91.5	% of CEC	Calc.
Mg	6.1	% of CEC	Calc.
Na	0.5	% of CEC	Calc.
K	1.7	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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Soil Report

Jodi McGraw Consulting
P.O. Box 221
Freedom, CA 95019
Attn: Jodi McGraw

Lab Number: 6050350-10/20
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: E-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	4.6	10-50	Low
Nitrate (NO_3-N)	13	20-100	Low
Total Available N	17	75-150	Low
Phosphorous(P_2O_5)	99	100-300	Low
Potassium (K_2O)	430	450-750	Low
Calcium (Ca)	5400	3608-4510	High
Magnesium (Mg)	260	360-721	Low
Sulfate (SO_4-S)	54	100-200	Low
Sodium (Na)	25	< 250	See SAR
Chloride (Cl)	81	1-100	OK
ECe (dS/m)	0.68	0.2-4	OK
Copper (Cu)	1.5	1 +	OK
Zinc (Zn)	0.60	3 +	Low
Iron (Fe)	11	8 +	OK
Manganese (Mn)	3.5	4 +	Low
Boron (B)	0.67	1-4	Low
SAR	0.31	0-6	OK
CEC (meq/100gms)	15	10-20	OK
ESP (%)	0.37	0-10	OK
pHs Value	7.3	6.5-7.5	OK
Organic Matter (%)	5.6		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
200	Phosphorous (P_2O_5)
150	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.0

Gypsum Requirement (needed for clay treatment)
0.5 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	6.3	mg/Kg	KCl
NH_3-N	2.3	mg/Kg	KCl
P	22	mg/Kg	Olsen
SP	75	%	Sat
pHs	7.3	unit	Sat
ECe	0.68	dS/m	Sat
Ca	6.0	meq/L	Sat
Mg	1.0	meq/L	Sat
Na	0.58	meq/L	Sat
K	0.49	meq/L	Sat
Cl	1.5	meq/L	Sat
SO_4-S	1.1	meq/L	Sat
SAR	0.31	ratio	Calc
B	0.34	mg/Kg	CaCl2
Cu	0.75	mg/Kg	DTPA
Zn	0.30	mg/Kg	DTPA
Fe	5.7	mg/Kg	DTPA
Mn	1.7	mg/Kg	DTPA

Data:			Method
OrgMat	5.6	%	WalkBk
Org-C	3.3	%	WalkBk
SMP Bufffer pH	7.37	unit	SMP
GypReq	0.57	meq/100g	GypSol
Ca	2700	mg/Kg	NH_4OAc
Mg	130	mg/Kg	NH_4OAc
Na	13	mg/Kg	NH_4OAc
K	180	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	15	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	89.3	% of CEC	Calc.
Mg	7.2	% of CEC	Calc.
Na	0.4	% of CEC	Calc.
K	3.0	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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Soil Report

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P.O. Box 221
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Attn: Jodi McGraw

Lab Number: 6050350-11/20
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: F-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	6.3	10-50	Low
Nitrate (NO_3-N)	20	20-100	OK
Total Available N	26	75-150	Low
Phosphorous(P_2O_5)	140	100-300	OK
Potassium (K_2O)	350	450-750	Low
Calcium (Ca)	4700	3712-4640	High
Magnesium (Mg)	780	371-742	High
Sulfate (SO_4-S)	33	100-200	Low
Sodium (Na)	37	< 250	See SAR
Chloride (Cl)	53	1-100	OK
ECe (dS/m)	0.54	0.2-4	OK
Copper (Cu)	1.6	1 +	OK
Zinc (Zn)	0.79	3 +	Low
Iron (Fe)	17	8 +	OK
Manganese (Mn)	2.2	4 +	Low
Boron (B)	0.63	1-4	Low
SAR	0.39	0-6	OK
CEC (meq/100gms)	15	10-20	OK
ESP (%)	0.53	0-10	OK
pHs Value	6.9	6.5-7.5	OK
Organic Matter (%)	3.6		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

100	Nitrogen (N)
150	Phosphorous (P_2O_5)
250	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep
needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.1

Gypsum Requirement (needed for clay treatment)
2.0 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	10	mg/Kg	KCl
NH_3-N	3.2	mg/Kg	KCl
P	31	mg/Kg	Olsen
SP	61	%	Sat
pHs	6.9	unit	Sat
ECe	0.54	dS/m	Sat
Ca	3.3	meq/L	Sat
Mg	1.6	meq/L	Sat
Na	0.61	meq/L	Sat
K	0.27	meq/L	Sat
Cl	1.2	meq/L	Sat
SO_4-S	0.83	meq/L	Sat
SAR	0.39	ratio	Calc
B	0.31	mg/Kg	CaCl2
Cu	0.79	mg/Kg	DTPA
Zn	0.40	mg/Kg	DTPA
Fe	8.7	mg/Kg	DTPA
Mn	1.1	mg/Kg	DTPA

Data:			Method
OrgMat	3.6	%	WalkBk
Org-C	2.1	%	WalkBk
SMP Bufffer pH	7.23	unit	SMP
GypReq	2.4	meq/100g	GypSol
Ca	2400	mg/Kg	NH_4OAc
Mg	390	mg/Kg	NH_4OAc
Na	19	mg/Kg	NH_4OAc
K	140	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	15	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	76.0	% of CEC	Calc.
Mg	20.9	% of CEC	Calc.
Na	0.5	% of CEC	Calc.
K	2.4	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

42 HANGAR WAY
WATSONVILLE
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TEL: 831-724-5422
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Work Order #: 6050350
Account #: 8350
Date Received: May 11, 2016
Date Reported: May 13, 2016

Soil Report

Jodi McGraw Consulting
P.O. Box 221
Freedom, CA 95019
Attn: Jodi McGraw

Lab Number: 6050350-12/20
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: F-2

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	3.9	10-50	Low
Nitrate (NO_3-N)	16	20-100	Low
Total Available N	20	75-150	Low
Phosphorous(P_2O_5)	100	100-300	OK
Potassium (K_2O)	210	450-750	Low
Calcium (Ca)	4500	3169-3962	High
Magnesium (Mg)	380	316-633	OK
Sulfate (SO_4-S)	33	100-200	Low
Sodium (Na)	31	< 250	See SAR
Chloride (Cl)	25	1-100	OK
ECe (dS/m)	0.42	0.2-4	OK
Copper (Cu)	2.0	1 +	OK
Zinc (Zn)	0.36	3 +	Low
Iron (Fe)	11	8 +	OK
Manganese (Mn)	1.6	4 +	Low
Boron (B)	0.49	1-4	Low
SAR	0.37	0-6	OK
CEC (meq/100gms)	13	10-20	OK
ESP (%)	0.51	0-10	OK
pHs Value	7.0	6.5-7.5	OK
Organic Matter (%)	2.8		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
200	Phosphorous (P_2O_5)
350	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep
needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.0

Gypsum Requirement (needed for clay treatment)
1.4 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	8.2	mg/Kg	KCl
NH_3-N	2.0	mg/Kg	KCl
P	23	mg/Kg	Olsen
SP	63	%	Sat
pHs	7.0	unit	Sat
ECe	0.42	dS/m	Sat
Ca	2.9	meq/L	Sat
Mg	0.74	meq/L	Sat
Na	0.50	meq/L	Sat
K	0.14	meq/L	Sat
Cl	0.56	meq/L	Sat
SO_4-S	0.81	meq/L	Sat
SAR	0.37	ratio	Calc
B	0.25	mg/Kg	CaCl2
Cu	1.0	mg/Kg	DTPA
Zn	0.18	mg/Kg	DTPA
Fe	5.7	mg/Kg	DTPA
Mn	0.81	mg/Kg	DTPA

Data:			Method
OrgMat	2.8	%	WalkBk
Org-C	1.6	%	WalkBk
SMP Bufffer pH	7.34	unit	SMP
GypReq	1.7	meq/100g	GypSol
Ca	2300	mg/Kg	NH_4OAc
Mg	190	mg/Kg	NH_4OAc
Na	15	mg/Kg	NH_4OAc
K	87	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	13	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	85.7	% of CEC	Calc.
Mg	12.0	% of CEC	Calc.
Na	0.5	% of CEC	Calc.
K	1.7	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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Date Received: May 11, 2016
Date Reported: May 13, 2016

Soil Report

Jodi McGraw Consulting
P.O. Box 221
Freedom, CA 95019
Attn: Jodi McGraw

Lab Number: 6050350-13/20
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: G-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	5.8	10-50	Low
Nitrate (NO_3-N)	45	20-100	OK
Total Available N	50	75-150	Low
Phosphorous(P_2O_5)	120	100-300	OK
Potassium (K_2O)	590	450-750	OK
Calcium (Ca)	4400	3342-4178	High
Magnesium (Mg)	500	334-668	OK
Sulfate (SO_4-S)	1400	100-200	High
Sodium (Na)	48	< 250	See SAR
Chloride (Cl)	130	1-100	High
ECe (dS/m)	2.7	0.2-4	OK
Copper (Cu)	3.4	1 +	OK
Zinc (Zn)	0.73	3 +	Low
Iron (Fe)	23	8 +	OK
Manganese (Mn)	5.4	4 +	OK
Boron (B)	0.94	1-4	Low
SAR	0.39	0-6	OK
CEC (meq/100gms)	14	10-20	OK
ESP (%)	0.75	0-10	OK
pHs Value	6.4	6.5-7.5	Low
Organic Matter (%)	4.1		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

75	Nitrogen (N)
150	Phosphorous (P_2O_5)
100	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.1
pH 7.0 needs	0.6

Gypsum Requirement (needed for clay treatment)
1.2 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	22	mg/Kg	KCl
NH_3-N	2.9	mg/Kg	KCl
P	27	mg/Kg	Olsen
SP	65	%	Sat
pHs	6.4	unit	Sat
ECe	2.7	dS/m	Sat
Ca	3.0	meq/L	Sat
Mg	1.6	meq/L	Sat
Na	0.60	meq/L	Sat
K	0.33	meq/L	Sat
Cl	2.8	meq/L	Sat
SO_4-S	34	meq/L	Sat
SAR	0.39	ratio	Calc
B	0.47	mg/Kg	CaCl2
Cu	1.7	mg/Kg	DTPA
Zn	0.37	mg/Kg	DTPA
Fe	11	mg/Kg	DTPA
Mn	2.7	mg/Kg	DTPA

Data:			Method
OrgMat	4.1	%	WalkBk
Org-C	2.4	%	WalkBk
SMP Bufffer pH	7.22	unit	SMP
GypReq	1.4	meq/100g	GypSol
Ca	2200	mg/Kg	NH_4OAc
Mg	250	mg/Kg	NH_4OAc
Na	24	mg/Kg	NH_4OAc
K	250	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	14	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	79.5	% of CEC	Calc.
Mg	15.0	% of CEC	Calc.
Na	0.7	% of CEC	Calc.
K	4.5	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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Soil Report

Jodi McGraw Consulting
P.O. Box 221
Freedom, CA 95019
Attn: Jodi McGraw

Lab Number: 6050350-14/20
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: G-2

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	5.3	10-50	Low
Nitrate (NO_3-N)	4.2	20-100	Low
Total Available N	9.5	75-150	Low
Phosphorous(P_2O_5)	210	100-300	OK
Potassium (K_2O)	340	450-750	Low
Calcium (Ca)	3300	2392-2991	High
Magnesium (Mg)	310	300-600	OK
Sulfate (SO_4-S)	100	100-200	OK
Sodium (Na)	26	< 250	See SAR
Chloride (Cl)	23	1-100	OK
ECe (dS/m)	0.59	0.2-4	OK
Copper (Cu)	2.9	1 +	OK
Zinc (Zn)	0.77	3 +	Low
Iron (Fe)	35	8 +	OK
Manganese (Mn)	1.6	4 +	Low
Boron (B)	0.29	1-4	Low
SAR	0.36	0-6	OK
CEC (meq/100gms)	10	10-20	OK
ESP (%)	0.57	0-10	OK
pHs Value	6.4	6.5-7.5	Low
Organic Matter (%)	2.8		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
50	Phosphorous (P_2O_5)
250	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.1
pH 7.0 needs	0.6

Gypsum Requirement (needed for clay treatment)
1.3 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	2.1	mg/Kg	KCl
NH_3-N	2.6	mg/Kg	KCl
P	47	mg/Kg	Olsen
SP	58	%	Sat
pHs	6.4	unit	Sat
ECe	0.59	dS/m	Sat
Ca	2.1	meq/L	Sat
Mg	0.68	meq/L	Sat
Na	0.42	meq/L	Sat
K	0.30	meq/L	Sat
Cl	0.56	meq/L	Sat
SO_4-S	2.7	meq/L	Sat
SAR	0.36	ratio	Calc
B	0.14	mg/Kg	CaCl2
Cu	1.5	mg/Kg	DTPA
Zn	0.38	mg/Kg	DTPA
Fe	17	mg/Kg	DTPA
Mn	0.79	mg/Kg	DTPA

Data:			Method
OrgMat	2.8	%	WalkBk
Org-C	1.7	%	WalkBk
SMP Bufffer pH	7.14	unit	SMP
GypReq	1.5	meq/100g	GypSol
Ca	1700	mg/Kg	NH_4OAc
Mg	150	mg/Kg	NH_4OAc
Na	13	mg/Kg	NH_4OAc
K	140	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	10	meq/100gm	Calc.
NH_3-N	0.2	% of CEC	Calc.
Ca	82.8	% of CEC	Calc.
Mg	12.8	% of CEC	Calc.
Na	0.6	% of CEC	Calc.
K	3.7	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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Date Reported: May 13, 2016

Soil Report

Jodi McGraw Consulting
P.O. Box 221
Freedom, CA 95019
Attn: Jodi McGraw

Lab Number: 6050350-15/20
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: H-1

	Your Values (lbs/acre 6" deep)	Suggested Values
Ammonia (NH_3-N)	3.4	10-50 Low
Nitrate (NO_3-N)	31	20-100 OK
Total Available N	35	75-150 Low
Phosphorous(P_2O_5)	76	100-300 Low
Potassium (K_2O)	350	450-750 Low
Calcium (Ca)	5000	3372-4215 High
Magnesium (Mg)	250	337-674 Low
Sulfate (SO_4-S)	41	100-200 Low
Sodium (Na)	22	< 250 See SAR
Chloride (Cl)	48	1-100 OK
ECe (dS/m)	0.72	0.2-4 OK
Copper (Cu)	0.91	1 + Low
Zinc (Zn)	0.34	3 + Low
Iron (Fe)	6.6	8 + Low
Manganese (Mn)	1.7	4 + Low
Boron (B)	0.80	1-4 Low
SAR	0.32	0-6 OK
CEC (meq/100gms)	14	10-20 OK
ESP (%)	0.34	0-10 OK
pHs Value	7.3	6.5-7.5 OK
Organic Matter (%)	3.7	

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

100	Nitrogen (N)
200	Phosphorous (P_2O_5)
200	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.0

Gypsum Requirement (needed for clay treatment)
0.8 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	16	mg/Kg	KCl
NH_3-N	1.7	mg/Kg	KCl
P	17	mg/Kg	Olsen
SP	67	%	Sat
pHs	7.3	unit	Sat
ECe	0.72	dS/m	Sat
Ca	6.3	meq/L	Sat
Mg	0.93	meq/L	Sat
Na	0.60	meq/L	Sat
K	0.42	meq/L	Sat
Cl	1.0	meq/L	Sat
SO_4-S	0.95	meq/L	Sat
SAR	0.32	ratio	Calc
B	0.40	mg/Kg	CaCl2
Cu	0.45	mg/Kg	DTPA
Zn	0.17	mg/Kg	DTPA
Fe	3.3	mg/Kg	DTPA
Mn	0.85	mg/Kg	DTPA

Data:			Method
OrgMat	3.7	%	WalkBk
Org-C	2.2	%	WalkBk
SMP Bufffer pH	7.56	unit	SMP
GypReq	0.90	meq/100g	GypSol
Ca	2500	mg/Kg	NH_4OAc
Mg	130	mg/Kg	NH_4OAc
Na	11	mg/Kg	NH_4OAc
K	150	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	14	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	89.4	% of CEC	Calc.
Mg	7.5	% of CEC	Calc.
Na	0.3	% of CEC	Calc.
K	2.7	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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Soil Report

Jodi McGraw Consulting
P.O. Box 221
Freedom, CA 95019
Attn: Jodi McGraw

Lab Number: 6050350-16/20
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: H-2

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	7.5	10-50	Low
Nitrate (NO_3-N)	38	20-100	OK
Total Available N	45	75-150	Low
Phosphorous(P_2O_5)	69	100-300	Low
Potassium (K_2O)	270	450-750	Low
Calcium (Ca)	5400	3586-4482	High
Magnesium (Mg)	230	358-717	Low
Sulfate (SO_4-S)	45	100-200	Low
Sodium (Na)	35	< 250	See SAR
Chloride (Cl)	75	1-100	OK
ECe (dS/m)	0.83	0.2-4	OK
Copper (Cu)	1.1	1 +	OK
Zinc (Zn)	0.29	3 +	Low
Iron (Fe)	6.8	8 +	Low
Manganese (Mn)	2.1	4 +	Low
Boron (B)	0.89	1-4	Low
SAR	0.38	0-6	OK
CEC (meq/100gms)	15	10-20	OK
ESP (%)	0.50	0-10	OK
pHs Value	7.5	6.5-7.5	OK
Organic Matter (%)	3.4		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

100	Nitrogen (N)
200	Phosphorous (P_2O_5)
300	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.0

Gypsum Requirement (needed for clay treatment)
0.6 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	19	mg/Kg	KCl
NH_3-N	3.8	mg/Kg	KCl
P	16	mg/Kg	Olsen
SP	68	%	Sat
pHs	7.5	unit	Sat
ECe	0.83	dS/m	Sat
Ca	6.9	meq/L	Sat
Mg	0.77	meq/L	Sat
Na	0.74	meq/L	Sat
K	0.23	meq/L	Sat
Cl	1.6	meq/L	Sat
SO_4-S	1.0	meq/L	Sat
SAR	0.38	ratio	Calc
B	0.44	mg/Kg	CaCl2
Cu	0.53	mg/Kg	DTPA
Zn	0.15	mg/Kg	DTPA
Fe	3.4	mg/Kg	DTPA
Mn	1.1	mg/Kg	DTPA

Data:			Method
OrgMat	3.4	%	WalkBk
Org-C	2.0	%	WalkBk
SMP Bufffer pH	7.55	unit	SMP
GypReq	0.75	meq/100g	GypSol
Ca	2700	mg/Kg	NH_4OAc
Mg	110	mg/Kg	NH_4OAc
Na	17	mg/Kg	NH_4OAc
K	110	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages			
CEC	15	meq/100gm	Calc.
NH_3-N	0.2	% of CEC	Calc.
Ca	91.1	% of CEC	Calc.
Mg	6.3	% of CEC	Calc.
Na	0.5	% of CEC	Calc.
K	1.9	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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Soil Report

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Attn: Jodi McGraw

Lab Number: 6050350-17/20
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: I-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	4.4	10-50	Low
Nitrate (NO_3-N)	14	20-100	Low
Total Available N	18	75-150	Low
Phosphorous(P_2O_5)	75	100-300	Low
Potassium (K_2O)	330	450-750	Low
Calcium (Ca)	3200	3343-4179	Low
Magnesium (Mg)	1300	334-668	High
Sulfate (SO_4-S)	22	100-200	Low
Sodium (Na)	83	< 250	See SAR
Chloride (Cl)	46	1-100	OK
ECe (dS/m)	0.37	0.2-4	OK
Copper (Cu)	1.0	1 +	Low
Zinc (Zn)	0.62	3 +	Low
Iron (Fe)	22	8 +	OK
Manganese (Mn)	2.8	4 +	Low
Boron (B)	0.36	1-4	Low
SAR	0.64	0-6	OK
CEC (meq/100gms)	14	10-20	OK
ESP (%)	1.3	0-10	OK
pHs Value	6.5	6.5-7.5	OK
Organic Matter (%)	4.0		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
200	Phosphorous (P_2O_5)
250	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
2000	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.5

Gypsum Requirement (needed for clay treatment)
3.4 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	6.9	mg/Kg	KCl
NH_3-N	2.2	mg/Kg	KCl
P	17	mg/Kg	Olsen
SP	59	%	Sat
pHs	6.5	unit	Sat
ECe	0.37	dS/m	Sat
Ca	2.3	meq/L	Sat
Mg	2.3	meq/L	Sat
Na	0.96	meq/L	Sat
K	0.24	meq/L	Sat
Cl	1.1	meq/L	Sat
SO_4-S	0.57	meq/L	Sat
SAR	0.64	ratio	Calc
B	0.18	mg/Kg	CaCl2
Cu	0.50	mg/Kg	DTPA
Zn	0.31	mg/Kg	DTPA
Fe	11	mg/Kg	DTPA
Mn	1.4	mg/Kg	DTPA

Data:			Method
OrgMat	4.0	%	WalkBk
Org-C	2.3	%	WalkBk
SMP Bufffer pH	7.18	unit	SMP
GypReq	4.0	meq/100g	GypSol
Ca	1600	mg/Kg	NH_4OAc
Mg	650	mg/Kg	NH_4OAc
Na	42	mg/Kg	NH_4OAc
K	140	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	14	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	57.1	% of CEC	Calc.
Mg	39.0	% of CEC	Calc.
Na	1.3	% of CEC	Calc.
K	2.5	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

42 HANGAR WAY WATSONVILLE CALIFORNIA 95076 USA

TEL: 831-724-5422
FAX: 831-724-3188

Work Order #: 6050350
Account #: 8350
Date Received: May 11, 2016
Date Reported: May 13, 2016

Soil Report

Jodi McGraw Consulting
P.O. Box 221
Freedom, CA 95019
Attn: Jodi McGraw

Lab Number: 6050350-18/20
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: I-2

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	6.6	10-50	Low
Nitrate (NO_3-N)	15	20-100	Low
Total Available N	22	75-150	Low
Phosphorous(P_2O_5)	63	100-300	Low
Potassium (K_2O)	370	450-750	Low
Calcium (Ca)	3800	3696-4620	OK
Magnesium (Mg)	1300	369-739	High
Sulfate (SO_4-S)	29	100-200	Low
Sodium (Na)	76	< 250	See SAR
Chloride (Cl)	49	1-100	OK
ECe (dS/m)	0.41	0.2-4	OK
Copper (Cu)	1.1	1 +	OK
Zinc (Zn)	0.94	3 +	Low
Iron (Fe)	21	8 +	OK
Manganese (Mn)	5.1	4 +	OK
Boron (B)	0.43	1-4	Low
SAR	0.75	0-6	OK
CEC (meq/100gms)	15	10-20	OK
ESP (%)	1.1	0-10	OK
pHs Value	6.5	6.5-7.5	OK
Organic Matter (%)	4.5		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
200	Phosphorous (P_2O_5)
200	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
2000	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.6

Gypsum Requirement (needed for clay treatment)
3.0 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	7.5	mg/Kg	KCl
NH_3-N	3.3	mg/Kg	KCl
P	14	mg/Kg	Olsen
SP	59	%	Sat
pHs	6.5	unit	Sat
ECe	0.41	dS/m	Sat
Ca	2.0	meq/L	Sat
Mg	1.7	meq/L	Sat
Na	1.0	meq/L	Sat
K	0.20	meq/L	Sat
Cl	1.2	meq/L	Sat
SO_4-S	0.78	meq/L	Sat
SAR	0.75	ratio	Calc
B	0.22	mg/Kg	CaCl2
Cu	0.53	mg/Kg	DTPA
Zn	0.47	mg/Kg	DTPA
Fe	10	mg/Kg	DTPA
Mn	2.5	mg/Kg	DTPA

Data:			Method
OrgMat	4.5	%	WalkBk
Org-C	2.6	%	WalkBk
SMP Bufffer pH	7.15	unit	SMP
GypReq	3.6	meq/100g	GypSol
Ca	1900	mg/Kg	NH_4OAc
Mg	640	mg/Kg	NH_4OAc
Na	38	mg/Kg	NH_4OAc
K	160	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	15	meq/100gm	Calc.
NH_3-N	0.2	% of CEC	Calc.
Ca	61.5	% of CEC	Calc.
Mg	34.7	% of CEC	Calc.
Na	1.1	% of CEC	Calc.
K	2.6	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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Work Order #: 6050350
Account #: 8350
Date Received: May 11, 2016
Date Reported: May 13, 2016

Soil Report

Jodi McGraw Consulting
P.O. Box 221
Freedom, CA 95019
Attn: Jodi McGraw

Lab Number: 6050350-19/20
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: J-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	4.7	10-50	Low
Nitrate (NO_3-N)	13	20-100	Low
Total Available N	18	75-150	Low
Phosphorous(P_2O_5)	74	100-300	Low
Potassium (K_2O)	350	450-750	Low
Calcium (Ca)	5100	3387-4234	High
Magnesium (Mg)	190	338-677	Low
Sulfate (SO_4-S)	21	100-200	Low
Sodium (Na)	25	< 250	See SAR
Chloride (Cl)	64	1-100	OK
ECe (dS/m)	0.65	0.2-4	OK
Copper (Cu)	0.56	1 +	Low
Zinc (Zn)	0.55	3 +	Low
Iron (Fe)	10	8 +	OK
Manganese (Mn)	1.5	4 +	Low
Boron (B)	1.3	1-4	OK
SAR	0.37	0-6	OK
CEC (meq/100gms)	14	10-20	OK
ESP (%)	0.39	0-10	OK
pHs Value	7.2	6.5-7.5	OK
Organic Matter (%)	5.0		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
200	Phosphorous (P_2O_5)
200	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.0

Gypsum Requirement (needed for clay treatment)
1.1 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	6.5	mg/Kg	KCl
NH_3-N	2.4	mg/Kg	KCl
P	17	mg/Kg	Olsen
SP	76	%	Sat
pHs	7.2	unit	Sat
ECe	0.65	dS/m	Sat
Ca	6.4	meq/L	Sat
Mg	0.92	meq/L	Sat
Na	0.71	meq/L	Sat
K	0.46	meq/L	Sat
Cl	1.2	meq/L	Sat
SO_4-S	0.42	meq/L	Sat
SAR	0.37	ratio	Calc
B	0.67	mg/Kg	CaCl2
Cu	0.28	mg/Kg	DTPA
Zn	0.27	mg/Kg	DTPA
Fe	5.2	mg/Kg	DTPA
Mn	0.73	mg/Kg	DTPA

Data:			Method
OrgMat	5.0	%	WalkBk
Org-C	2.9	%	WalkBk
SMP Bufffer pH	7.53	unit	SMP
GypReq	1.3	meq/100g	GypSol
Ca	2600	mg/Kg	NH_4OAc
Mg	97	mg/Kg	NH_4OAc
Na	13	mg/Kg	NH_4OAc
K	150	mg/Kg	NH_4OAc
Moisture	NA	%	Oven dry

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	14	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	91.1	% of CEC	Calc.
Mg	5.7	% of CEC	Calc.
Na	0.4	% of CEC	Calc.
K	2.6	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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Work Order #: 6050350
Account #: 8350
Date Received: May 11, 2016
Date Reported: May 13, 2016

Soil Report

Jodi McGraw Consulting
P.O. Box 221
Freedom, CA 95019
Attn: Jodi McGraw

Lab Number: 6050350-20/20
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: J-2

	Your Values (lbs/acre 6" deep)	Suggested Values
Ammonia (NH_3-N)	6.9	10-50 Low
Nitrate (NO_3-N)	19	20-100 Low
Total Available N	26	75-150 Low
Phosphorous(P_2O_5)	96	100-300 Low
Potassium (K_2O)	340	450-750 Low
Calcium (Ca)	5300	3532-4415 High
Magnesium (Mg)	230	353-706 Low
Sulfate (SO_4-S)	37	100-200 Low
Sodium (Na)	36	< 250 See SAR
Chloride (Cl)	80	1-100 OK
ECe (dS/m)	0.77	0.2-4 OK
Copper (Cu)	0.70	1 + Low
Zinc (Zn)	0.73	3 + Low
Iron (Fe)	9.6	8 + OK
Manganese (Mn)	1.6	4 + Low
Boron (B)	1.3	1-4 OK
SAR	0.43	0-6 OK
CEC (meq/100gms)	15	10-20 OK
ESP (%)	0.54	0-10 OK
pHs Value	7.3	6.5-7.5 OK
Organic Matter (%)	5.6	

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

100	Nitrogen (N)
200	Phosphorous (P_2O_5)
250	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.0

Gypsum Requirement (needed for clay treatment)
0.7 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	9.6	mg/Kg	KCl
NH_3-N	3.4	mg/Kg	KCl
P	22	mg/Kg	Olsen
SP	66	%	Sat
pHs	7.3	unit	Sat
ECe	0.77	dS/m	Sat
Ca	7.0	meq/L	Sat
Mg	0.94	meq/L	Sat
Na	0.86	meq/L	Sat
K	0.35	meq/L	Sat
Cl	1.7	meq/L	Sat
SO_4-S	0.87	meq/L	Sat
SAR	0.43	ratio	Calc
B	0.66	mg/Kg	CaCl2
Cu	0.35	mg/Kg	DTPA
Zn	0.36	mg/Kg	DTPA
Fe	4.8	mg/Kg	DTPA
Mn	0.81	mg/Kg	DTPA

Data:			Method
OrgMat	5.6	%	WalkBk
Org-C	3.2	%	WalkBk
SMP Bufffer pH	7.48	unit	SMP
GypReq	0.82	meq/100g	GypSol
Ca	2700	mg/Kg	NH_4OAc
Mg	120	mg/Kg	NH_4OAc
Na	18	mg/Kg	NH_4OAc
K	140	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	15	meq/100gm	Calc.
NH_3-N	0.2	% of CEC	Calc.
Ca	90.2	% of CEC	Calc.
Mg	6.6	% of CEC	Calc.
Na	0.5	% of CEC	Calc.
K	2.5	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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6050350-20-8350

Jodi McGraw Consulting
P.O. Box 221
Freedom, CA 95019
Attn: Jodi McGraw

May 13, 2016

Particle Size Distribution

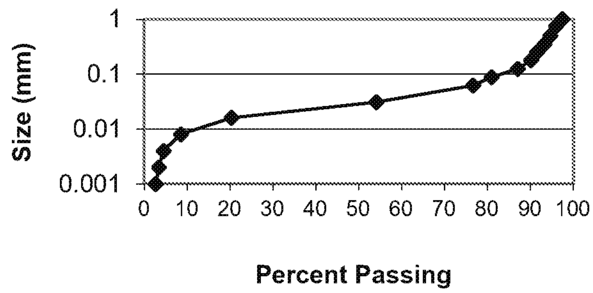
LABORATORY #: 6050350-1/20
IDENTIFICATION: A-0
DATE RECEIVED: May 11, 2016

*Gravel and stones are removed first

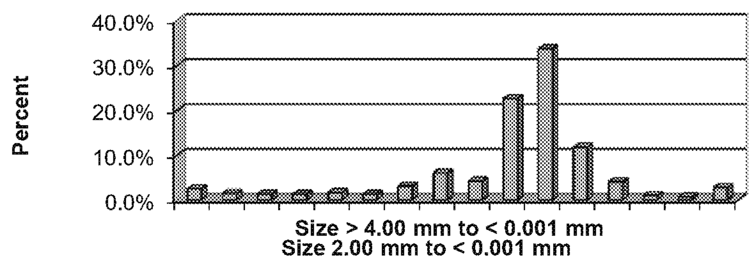
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	2.6%	2.6%
1 to 0.75		1.5%	4.0%
0.75-0.50		1.4%	5.4%
0.50-0.35		1.3%	6.8%
0.35-0.25		1.7%	8.4%
0.25-0.18		1.4%	9.8%
0.18-0.125		3.1%	12.9%
0.125-0.088		6.1%	19.0%
0.088-0.062		4.2%	23.3%
0.062-0.031	Silt	22.6%	45.9%
0.031-0.016		33.7%	79.6%
0.016-0.008		11.8%	91.4%
0.008-0.004		4.1%	95.5%
0.004-0.002		1.0%	96.5%
0.002-0.001	Clay	0.7%	97.2%
< 0.001		2.8%	100.0%

*Gravel % based on whole sample (nothing removed)

Gravel		3.2%	-



Very Coarse Sand %	2.6%		
Coarse Sand %	2.8%		
Medium Sand %	3.0%		
Fine Sand %	10.6%		
Very Fine Sand %	4.2%		
Classification:	**Silty Loam**		
Sand	23.3%		
Silt	73.2%		
Clay	3.5%		
Effective Size (mm):	10%	=	0.0090
	60%	=	0.0391
Uniformity Coeff. (60%/10%)		=	4.37



Mike Galloway

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6050350-20-8350

Jodi McGraw Consulting
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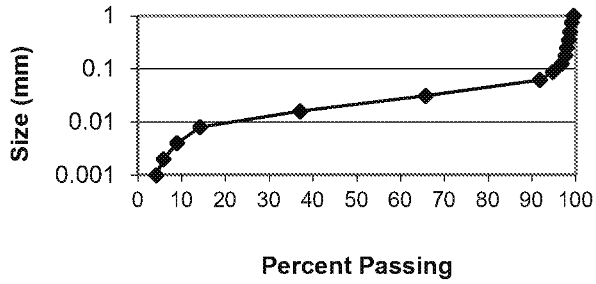
Attn: Jodi McGraw

May 13, 2016

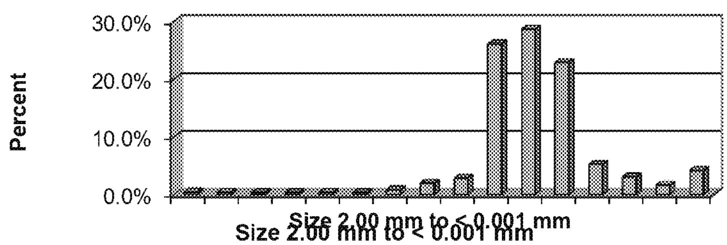
Particle Size Distribution

LABORATORY #: 6050350-2/20
IDENTIFICATION: A-1
DATE RECEIVED: May 11, 2016

*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	0.5%	0.5%
1 to 0.75		0.4%	0.9%
0.75-0.50		0.4%	1.3%
0.50-0.35		0.4%	1.6%
0.35-0.25		0.4%	2.1%
0.25-0.18		0.4%	2.4%
0.18-0.125		0.8%	3.3%
0.125-0.088		2.0%	5.3%
0.088-0.062		2.9%	8.2%
0.062-0.031	Silt	26.1%	34.3%
0.031-0.016		28.6%	62.9%
0.016-0.008		22.9%	85.8%
0.008-0.004		5.2%	91.0%
0.004-0.002		3.1%	94.1%
0.002-0.001	Clay	1.7%	95.8%
< 0.001		4.2%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		2.9%	-



Very Coarse Sand %	0.5%		
Coarse Sand %	0.8%		
Medium Sand %	0.8%		
Fine Sand %	3.2%		
Very Fine Sand %	2.9%		
Classification:	**Silt**		
Sand	8.2%		
Silt	85.9%		
Clay	5.9%		
Effective Size (mm):	10%	=	0.0048
	60%	=	0.0280
Uniformity Coeff. (60%/10%)		=	5.88



Mike Galloway

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6050350-20-8350

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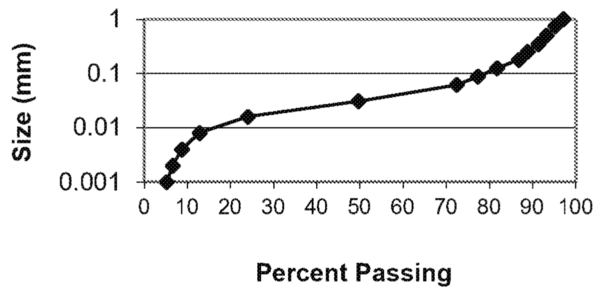
Freedom, CA 95019
Attn: Jodi McGraw

May 13, 2016

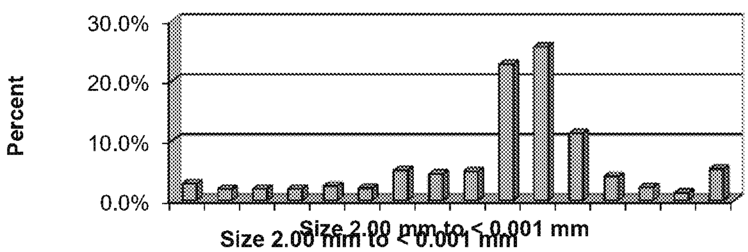
Particle Size Distribution

LABORATORY #: 6050350-3/20
IDENTIFICATION: A-2
DATE RECEIVED: May 11, 2016

*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	2.8%	2.8%
1 to 0.75		1.9%	4.8%
0.75-0.50		2.0%	6.7%
0.50-0.35		2.0%	8.7%
0.35-0.25		2.4%	11.1%
0.25-0.18		2.1%	13.2%
0.18-0.125		5.0%	18.2%
0.125-0.088		4.5%	22.7%
0.088-0.062		4.9%	27.5%
0.062-0.031	Silt	22.7%	50.3%
0.031-0.016		25.7%	76.0%
0.016-0.008		11.2%	87.2%
0.008-0.004		4.0%	91.2%
0.004-0.002		2.2%	93.4%
0.002-0.001	Clay	1.3%	94.7%
< 0.001		5.3%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		3.9%	-



Very Coarse Sand %	2.8%		
Coarse Sand %	3.9%		
Medium Sand %	4.4%		
Fine Sand %	11.6%		
Very Fine Sand %	4.9%		
Classification:	**Silty Loam**		
Sand	27.5%		
Silt	65.9%		
Clay	6.6%		
Effective Size (mm):	10%	=	0.0052
	60%	=	0.0450
Uniformity Coeff. (60%/10%)		=	8.63



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6050350-20-8350

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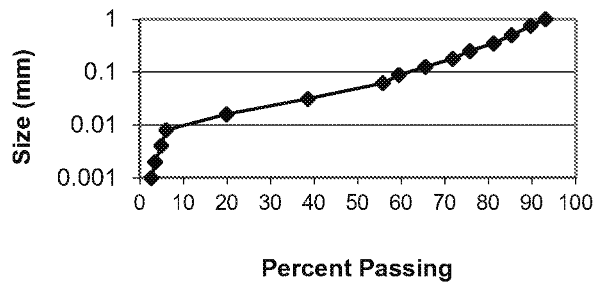
May 13, 2016

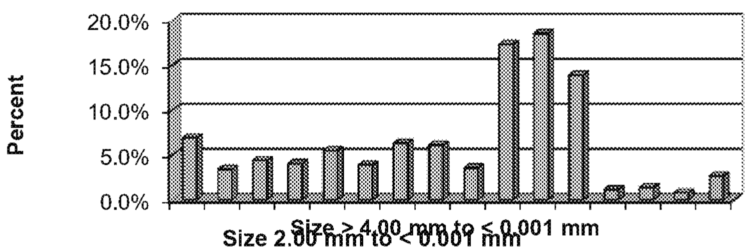
Particle Size Distribution

LABORATORY #: 6050350-4/20
IDENTIFICATION: A-3
DATE RECEIVED: May 11, 2016



*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	6.9%	6.9%
1 to 0.75		3.4%	10.3%
0.75-0.50		4.4%	14.7%
0.50-0.35		4.1%	18.8%
0.35-0.25		5.5%	24.3%
0.25-0.18		3.9%	28.2%
0.18-0.125		6.3%	34.5%
0.125-0.088		6.1%	40.6%
0.088-0.062		3.6%	44.2%
0.062-0.031	Silt	17.3%	61.5%
0.031-0.016		18.5%	80.1%
0.016-0.008		13.9%	94.0%
0.008-0.004		1.2%	95.1%
0.004-0.002		1.4%	96.5%
0.002-0.001	Clay	0.8%	97.3%
< 0.001		2.7%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		10.2%	-

Very Coarse Sand %	6.9%		
Coarse Sand %	7.8%		
Medium Sand %	9.5%		
Fine Sand %	16.3%		
Very Fine Sand %	3.6%		
Classification:	**Silty Loam**		
Sand	44.2%		
Silt	52.3%		
Clay	3.5%		
Effective Size (mm):	10%	=	0.0103
	60%	=	0.0917
Uniformity Coeff. (60%/10%)		=	8.91



Mike Galloway

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6050350-20-8350

Jodi McGraw Consulting
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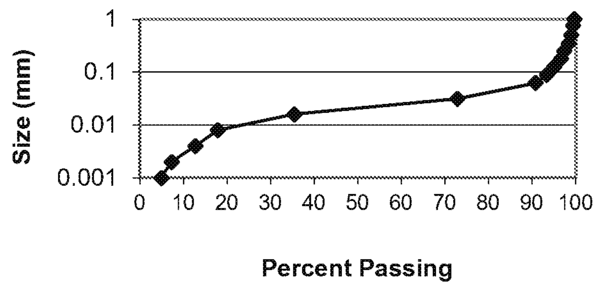
Attn: Jodi McGraw

May 13, 2016

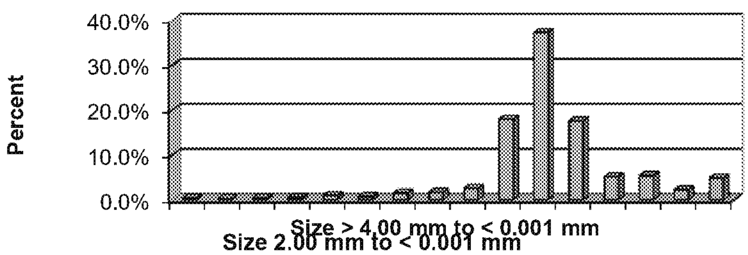
Particle Size Distribution

LABORATORY #: 6050350-5/20
IDENTIFICATION: B-1
DATE RECEIVED: May 11, 2016

*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	0.4%	0.4%
1 to 0.75		0.3%	0.6%
0.75-0.50		0.5%	1.1%
0.50-0.35		0.6%	1.7%
0.35-0.25		1.0%	2.7%
0.25-0.18		0.8%	3.4%
0.18-0.125		1.5%	5.0%
0.125-0.088		1.7%	6.7%
0.088-0.062		2.6%	9.2%
0.062-0.031	Silt	18.0%	27.2%
0.031-0.016		37.3%	64.5%
0.016-0.008		17.6%	82.1%
0.008-0.004		5.2%	87.3%
0.004-0.002		5.4%	92.7%
0.002-0.001	Clay	2.3%	95.1%
< 0.001		4.9%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		0.0%	-



Very Coarse Sand %	0.4%		
Coarse Sand %	0.7%		
Medium Sand %	1.6%		
Fine Sand %	4.0%		
Very Fine Sand %	2.6%		
Classification:	**Silt**		
Sand	9.2%		
Silt	83.5%		
Clay	7.3%		
Effective Size (mm):	10%	=	0.0030
	60%	=	0.0259
Uniformity Coeff. (60%/10%)		=	8.59



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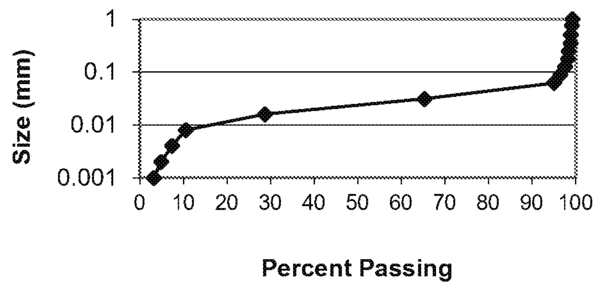
May 13, 2016

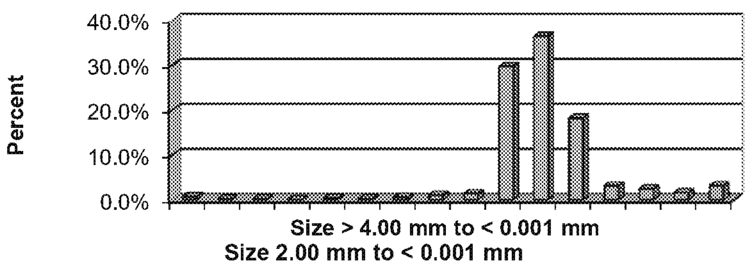
Particle Size Distribution

LABORATORY #: 6050350-6/20
IDENTIFICATION: B-2
DATE RECEIVED: May 11, 2016

*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	0.7%	0.7%
1 to 0.75		0.2%	0.9%
0.75-0.50		0.2%	1.1%
0.50-0.35		0.1%	1.3%
0.35-0.25		0.4%	1.6%
0.25-0.18		0.2%	1.9%
0.18-0.125		0.6%	2.5%
0.125-0.088		1.1%	3.6%
0.088-0.062		1.4%	5.0%
0.062-0.031	Silt	29.7%	34.7%
0.031-0.016		36.5%	71.3%
0.016-0.008		18.3%	89.5%
0.008-0.004		3.2%	92.7%
0.004-0.002		2.5%	95.1%
0.002-0.001	Clay	1.7%	96.8%
< 0.001		3.2%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		0.7%	-



Very Coarse Sand %	0.7%		
Coarse Sand %	0.4%		
Medium Sand %	0.5%		
Fine Sand %	1.9%		
Very Fine Sand %	1.4%		
Classification:	**Silt**		
Sand	5.0%		
Silt	90.1%		
Clay	4.9%		
Effective Size (mm):	10%	=	0.0074
	60%	=	0.0288
Uniformity Coeff. (60%/10%)		=	3.91



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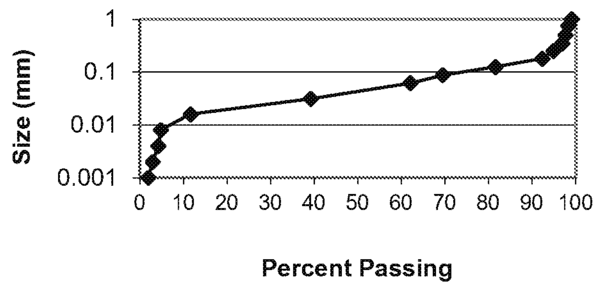
Particle Size Distribution

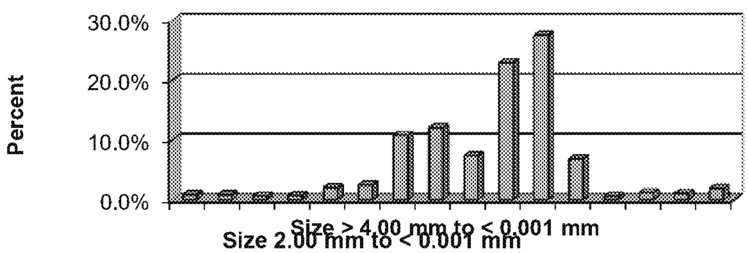
LABORATORY #:	6050350-7/20
IDENTIFICATION:	C-1
DATE RECEIVED:	May 11, 2016

*Gravel and stones are removed first

SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	0.9%	0.9%
1 to 0.75		0.9%	1.7%
0.75-0.50		0.6%	2.4%
0.50-0.35		0.7%	3.1%
0.35-0.25		2.1%	5.1%
0.25-0.18		2.5%	7.6%
0.18-0.125		10.8%	18.5%
0.125-0.088		12.0%	30.5%
0.088-0.062		7.4%	37.9%
0.062-0.031	Silt	22.9%	60.8%
0.031-0.016		27.5%	88.3%
0.016-0.008		6.9%	95.2%
0.008-0.004		0.6%	95.8%
0.004-0.002		1.2%	97.0%
0.002-0.001	Clay	1.1%	98.1%
< 0.001		1.9%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		0.8%	-



Very Coarse Sand %	0.9%		
Coarse Sand %	1.5%		
Medium Sand %	2.8%		
Fine Sand %	25.4%		
Very Fine Sand %	7.4%		
Classification:	**Silty Loam**		
Sand	37.9%		
Silt	59.1%		
Clay	3.0%		
Effective Size (mm):	10%	=	0.0141
	60%	=	0.0592
Uniformity Coeff. (60%/10%)		=	4.20



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Particle Size Distribution

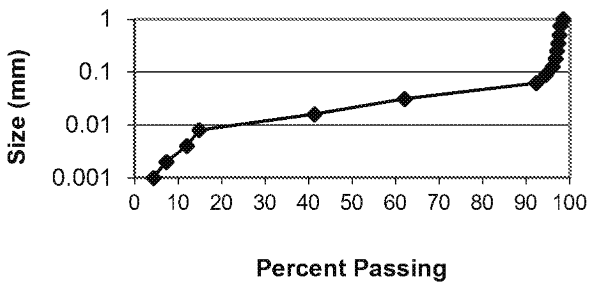
LABORATORY #: 6050350-8/20
IDENTIFICATION: D-1
DATE RECEIVED: May 11, 2016

*Gravel and stones are removed first

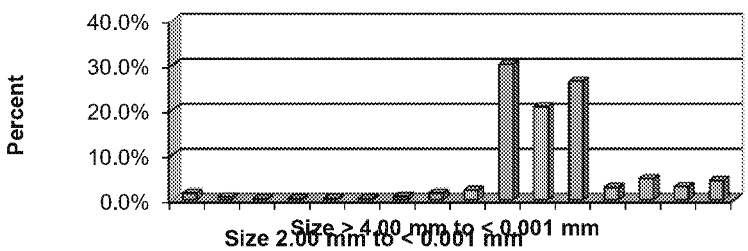
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	1.5%	1.5%
1 to 0.75		0.7%	2.2%
0.75-0.50		0.2%	2.4%
0.50-0.35		0.2%	2.7%
0.35-0.25		0.3%	3.0%
0.25-0.18		0.2%	3.2%
0.18-0.125		0.7%	3.9%
0.125-0.088		1.5%	5.5%
0.088-0.062		2.2%	7.7%
0.062-0.031	Silt	30.2%	37.9%
0.031-0.016		20.8%	58.7%
0.016-0.008		26.5%	85.2%
0.008-0.004		2.8%	88.0%
0.004-0.002		4.7%	92.7%
0.002-0.001	Clay	3.0%	95.7%
< 0.001		4.3%	100.0%

*Gravel % based on whole sample (nothing removed)

Gravel		1.4%	-



Very Coarse Sand %	1.5%		
Coarse Sand %	0.9%		
Medium Sand %	0.5%		
Fine Sand %	2.5%		
Very Fine Sand %	2.2%		
Classification:	**Silt**		
Sand	7.7%		
Silt	85.0%		
Clay	7.3%		
Effective Size (mm):	10%	=	0.0032
	60%	=	0.0295
Uniformity Coeff. (60%/10%)		=	9.34



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Particle Size Distribution

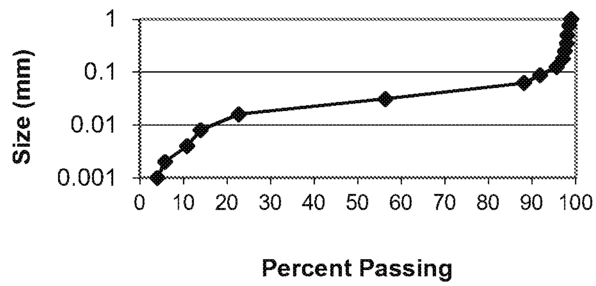
LABORATORY #: 6050350-9/20
IDENTIFICATION: D-2
DATE RECEIVED: May 11, 2016

*Gravel and stones are removed first

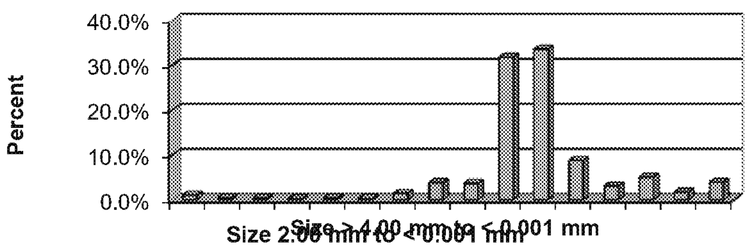
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	1.1%	1.1%
1 to 0.75		0.4%	1.5%
0.75-0.50		0.4%	1.9%
0.50-0.35		0.2%	2.1%
0.35-0.25		0.5%	2.6%
0.25-0.18		0.3%	2.9%
0.18-0.125		1.5%	4.4%
0.125-0.088		3.9%	8.2%
0.088-0.062		3.7%	11.9%
0.062-0.031	Silt	31.8%	43.7%
0.031-0.016		33.6%	77.3%
0.016-0.008		8.8%	86.1%
0.008-0.004		3.1%	89.2%
0.004-0.002		5.1%	94.3%
0.002-0.001	Clay	1.8%	96.0%
< 0.001		4.0%	100.0%

*Gravel % based on whole sample (nothing removed)

Gravel		0.4%	-



Very Coarse Sand %	1.1%		
Coarse Sand %	0.8%		
Medium Sand %	0.7%		
Fine Sand %	5.6%		
Very Fine Sand %	3.7%		
Classification:	**Silt**		
Sand	11.9%		
Silt	82.3%		
Clay	5.7%		
Effective Size (mm):	10%	=	0.0037
	60%	=	0.0346
Uniformity Coeff. (60%/10%)		=	9.41



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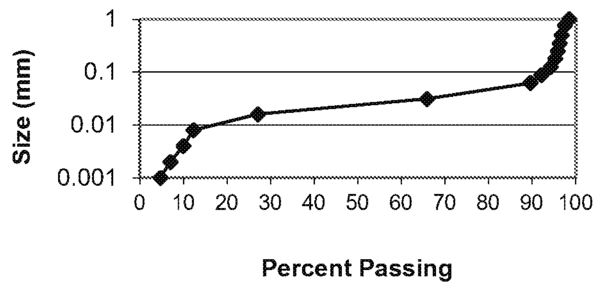
May 13, 2016

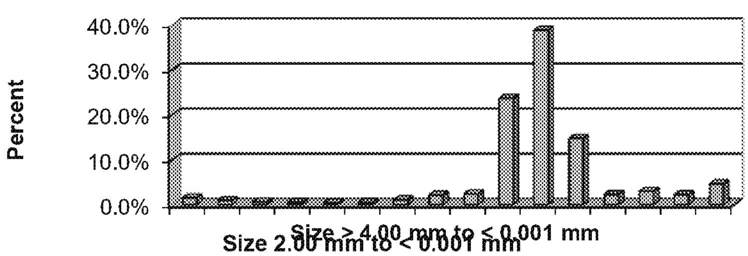
Particle Size Distribution

LABORATORY #: 6050350-10/20
IDENTIFICATION: E-1
DATE RECEIVED: May 11, 2016

*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	1.6%	1.6%
1 to 0.75		1.0%	2.5%
0.75-0.50		0.7%	3.2%
0.50-0.35		0.6%	3.7%
0.35-0.25		0.4%	4.1%
0.25-0.18		0.5%	4.7%
0.18-0.125		1.1%	5.8%
0.125-0.088		2.2%	7.9%
0.088-0.062		2.4%	10.4%
0.062-0.031	Silt	23.7%	34.1%
0.031-0.016		38.8%	72.9%
0.016-0.008		14.8%	87.7%
0.008-0.004		2.3%	90.0%
0.004-0.002		3.0%	93.0%
0.002-0.001	Clay	2.3%	95.3%
< 0.001		4.7%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		2.1%	-



Very Coarse Sand %	1.6%		
Coarse Sand %	1.6%		
Medium Sand %	1.0%		
Fine Sand %	3.8%		
Very Fine Sand %	2.4%		
Classification:	**Silt**		
Sand	10.4%		
Silt	82.6%		
Clay	7.0%		
Effective Size (mm):	10%	=	0.0040
	60%	=	0.0287
Uniformity Coeff. (60%/10%)		=	7.16



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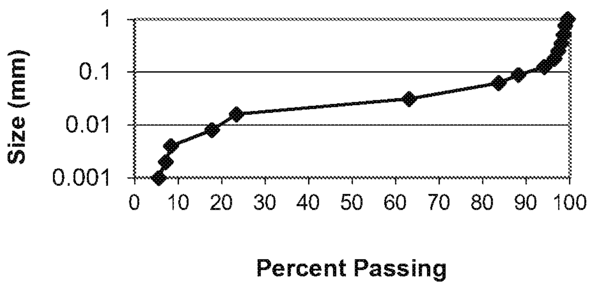
May 13, 2016

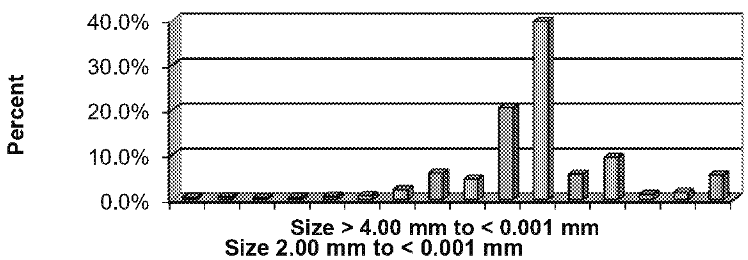
Particle Size Distribution

LABORATORY #: 6050350-11/20
IDENTIFICATION: F-1
DATE RECEIVED: May 11, 2016

*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	0.5%	0.5%
1 to 0.75		0.6%	1.1%
0.75-0.50		0.4%	1.5%
0.50-0.35		0.5%	2.0%
0.35-0.25		0.7%	2.7%
0.25-0.18		0.9%	3.6%
0.18-0.125		2.3%	5.9%
0.125-0.088		5.9%	11.8%
0.088-0.062		4.6%	16.4%
0.062-0.031	Silt	20.5%	36.9%
0.031-0.016		39.7%	76.6%
0.016-0.008		5.7%	82.2%
0.008-0.004		9.5%	91.7%
0.004-0.002		1.2%	92.9%
0.002-0.001	Clay	1.7%	94.5%
< 0.001		5.5%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		0.7%	-



Very Coarse Sand %		0.5%		
Coarse Sand %		1.0%		
Medium Sand %		1.2%		
Fine Sand %		9.1%		
Very Fine Sand %		4.6%		
Classification:	**Silt**			
	Sand	16.4%		
	Silt	76.5%		
	Clay	7.1%		
Effective Size (mm):		10%	=	0.0047
		60%	=	0.0298
Uniformity Coeff. (60%/10%)			=	6.33



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May 13, 2016

Particle Size Distribution

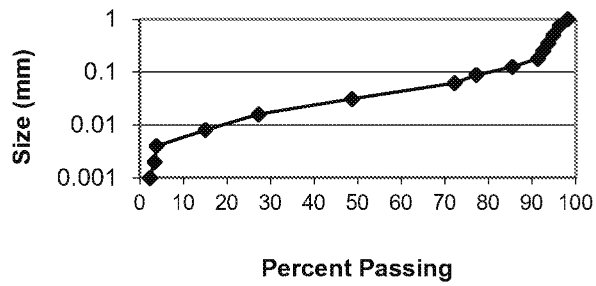
LABORATORY #: 6050350-12/20
IDENTIFICATION: F-2
DATE RECEIVED: May 11, 2016

*Gravel and stones are removed first

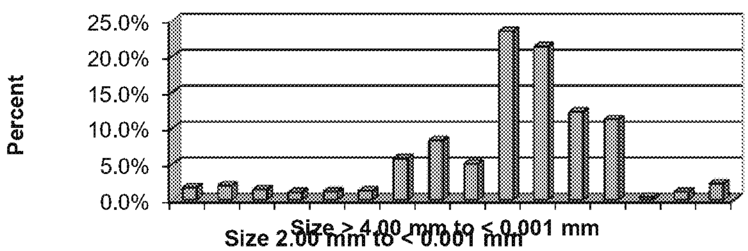
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	1.7%	1.7%
1 to 0.75		2.0%	3.7%
0.75-0.50		1.5%	5.2%
0.50-0.35		1.1%	6.3%
0.35-0.25		1.2%	7.5%
0.25-0.18		1.3%	8.7%
0.18-0.125		5.8%	14.5%
0.125-0.088		8.3%	22.8%
0.088-0.062		5.0%	27.8%
0.062-0.031	Silt	23.5%	51.3%
0.031-0.016		21.4%	72.7%
0.016-0.008		12.3%	85.0%
0.008-0.004		11.2%	96.2%
0.004-0.002		0.4%	96.6%
0.002-0.001	Clay	1.1%	97.7%
< 0.001		2.3%	100.0%

*Gravel % based on whole sample (nothing removed)

Gravel		2.0%	-



Very Coarse Sand %	1.7%		
Coarse Sand %	3.5%		
Medium Sand %	2.2%		
Fine Sand %	15.3%		
Very Fine Sand %	5.0%		
Classification:	**Silty Loam**		
Sand	27.8%		
Silt	68.8%		
Clay	3.4%		
Effective Size (mm):	10%	=	0.0062
	60%	=	0.0460
Uniformity Coeff. (60%/10%)		=	7.40



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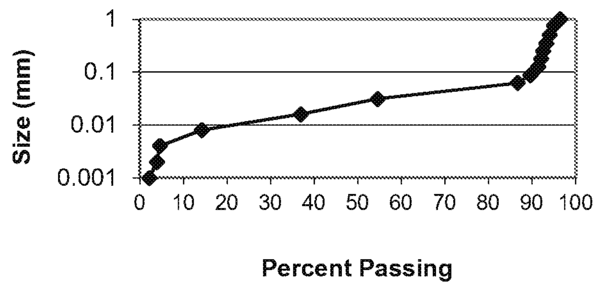
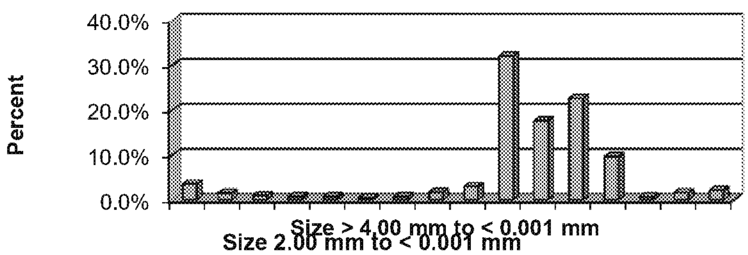
Particle Size Distribution

LABORATORY #: 6050350-13/20
IDENTIFICATION: G-1
DATE RECEIVED: May 11, 2016



*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	3.6%	3.6%
1 to 0.75		1.5%	5.1%
0.75-0.50		1.0%	6.0%
0.50-0.35		0.7%	6.8%
0.35-0.25		0.7%	7.5%
0.25-0.18		0.5%	8.0%
0.18-0.125		0.7%	8.7%
0.125-0.088		1.7%	10.4%
0.088-0.062		3.0%	13.4%
0.062-0.031	Silt	32.1%	45.5%
0.031-0.016		17.7%	63.1%
0.016-0.008		22.6%	85.8%
0.008-0.004		9.7%	95.4%
0.004-0.002		0.7%	96.1%
0.002-0.001	Clay	1.7%	97.8%
< 0.001		2.2%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		8.6%	-

Very Coarse Sand %	3.6%		
Coarse Sand %	2.5%		
Medium Sand %	1.5%		
Fine Sand %	2.9%		
Very Fine Sand %	3.0%		
Classification:	**Silt**		
Sand	13.4%		
Silt	82.7%		
Clay	3.9%		
Effective Size (mm):	10%	=	0.0063
	60%	=	0.0363
Uniformity Coeff. (60%/10%)		=	5.80



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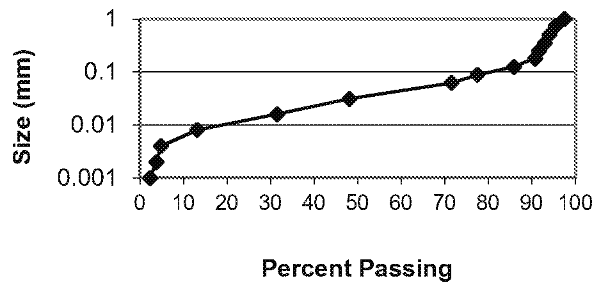
May 13, 2016

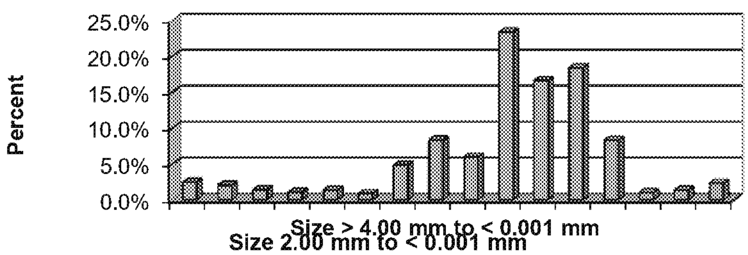
Particle Size Distribution

LABORATORY #: 6050350-14/20
IDENTIFICATION: G-2
DATE RECEIVED: May 11, 2016

*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	2.5%	2.5%
1 to 0.75		2.1%	4.5%
0.75-0.50		1.5%	6.0%
0.50-0.35		1.1%	7.1%
0.35-0.25		1.4%	8.5%
0.25-0.18		0.9%	9.3%
0.18-0.125		4.9%	14.2%
0.125-0.088		8.3%	22.5%
0.088-0.062		6.0%	28.5%
0.062-0.031	Silt	23.4%	51.9%
0.031-0.016		16.6%	68.5%
0.016-0.008		18.4%	86.9%
0.008-0.004		8.3%	95.2%
0.004-0.002		1.0%	96.3%
0.002-0.001	Clay	1.4%	97.7%
< 0.001		2.3%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		5.4%	-



Very Coarse Sand %	2.5%		
Coarse Sand %	3.5%		
Medium Sand %	2.4%		
Fine Sand %	14.1%		
Very Fine Sand %	6.0%		
Classification:	**Silty Loam**		
Sand	28.5%		
Silt	67.7%		
Clay	3.7%		
Effective Size (mm):	10%	=	0.0065
	60%	=	0.0468
Uniformity Coeff. (60%/10%)		=	7.18



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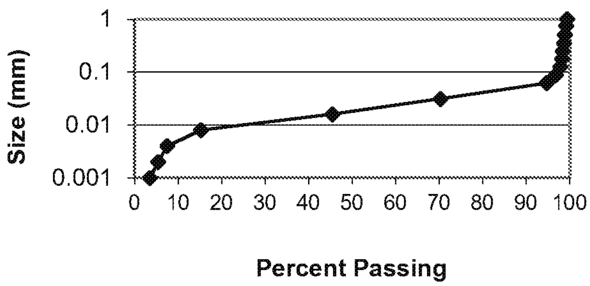
May 13, 2016

Particle Size Distribution

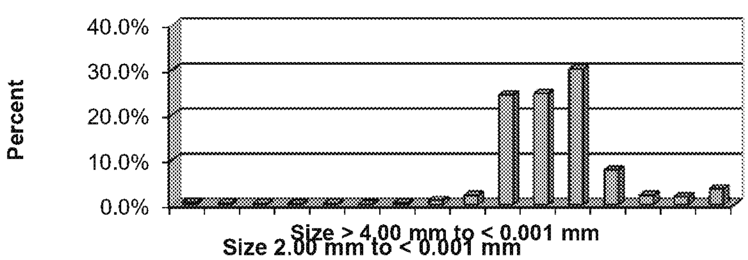
LABORATORY #: 6050350-15/20
IDENTIFICATION: H-1
DATE RECEIVED: May 11, 2016

*Gravel and stones are removed first

SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	0.6%	0.6%
1 to 0.75		0.3%	0.9%
0.75-0.50		0.3%	1.2%
0.50-0.35		0.2%	1.4%
0.35-0.25		0.3%	1.6%
0.25-0.18		0.2%	1.8%
0.18-0.125		0.4%	2.2%
0.125-0.088		1.0%	3.2%
0.088-0.062		2.1%	5.3%
0.062-0.031	Silt	24.4%	29.8%
0.031-0.016		24.8%	54.6%
0.016-0.008		30.2%	84.8%
0.008-0.004		7.7%	92.5%
0.004-0.002		2.1%	94.6%
0.002-0.001	Clay	1.8%	96.5%
< 0.001		3.5%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		1.0%	-



Very Coarse Sand %	0.6%		
Coarse Sand %	0.6%		
Medium Sand %	0.5%		
Fine Sand %	1.6%		
Very Fine Sand %	2.1%		
Classification:	**Silt**		
Sand	5.3%		
Silt	89.3%		
Clay	5.4%		
Effective Size (mm):	10%	=	0.0053
	60%	=	0.0248
Uniformity Coeff. (60%/10%)		=	4.69



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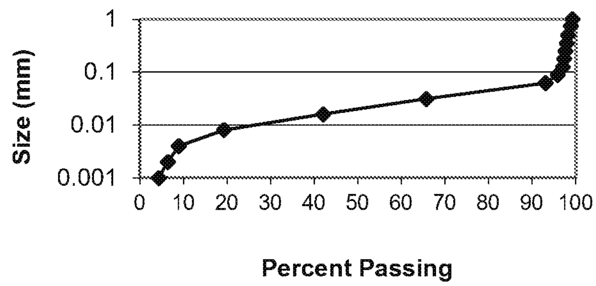
May 13, 2016

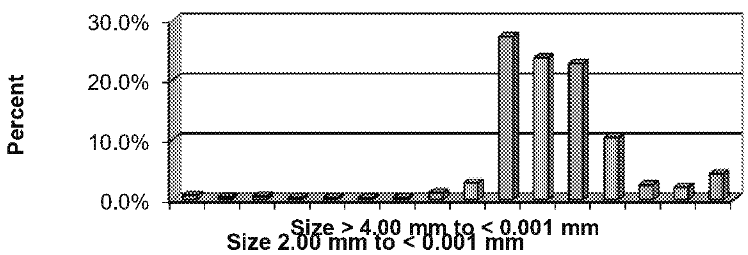
Particle Size Distribution

LABORATORY #: 6050350-16/20
IDENTIFICATION: H-2
DATE RECEIVED: May 11, 2016

*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	0.7%	0.7%
1 to 0.75		0.4%	1.2%
0.75-0.50		0.6%	1.7%
0.50-0.35		0.4%	2.1%
0.35-0.25		0.3%	2.4%
0.25-0.18		0.3%	2.7%
0.18-0.125		0.3%	3.0%
0.125-0.088		1.2%	4.2%
0.088-0.062		2.8%	7.0%
0.062-0.031	Silt	27.3%	34.2%
0.031-0.016		23.7%	58.0%
0.016-0.008		22.7%	80.7%
0.008-0.004		10.4%	91.1%
0.004-0.002		2.5%	93.6%
0.002-0.001	Clay	2.1%	95.7%
< 0.001		4.3%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		0.0%	-



Very Coarse Sand %	0.7%		
Coarse Sand %	1.0%		
Medium Sand %	0.7%		
Fine Sand %	1.8%		
Very Fine Sand %	2.8%		
Classification:	**Silt**		
Sand	7.0%		
Silt	86.6%		
Clay	6.4%		
Effective Size (mm):	10%	=	0.0044
	60%	=	0.0274
Uniformity Coeff. (60%/10%)		=	6.18



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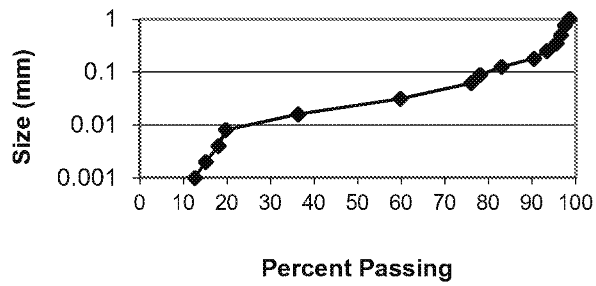
May 13, 2016

Particle Size Distribution

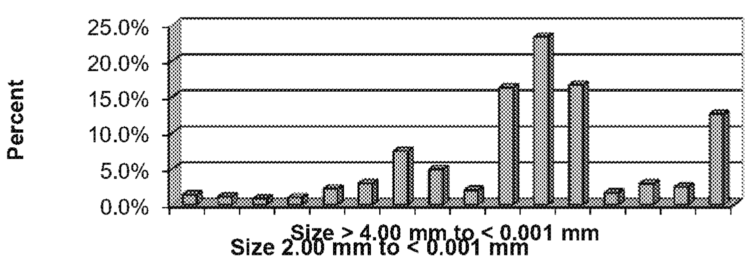
LABORATORY #: 6050350-17/20
IDENTIFICATION: I-1
DATE RECEIVED: May 11, 2016

*Gravel and stones are removed first

SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	1.4%	1.4%
1 to 0.75		1.1%	2.5%
0.75-0.50		0.8%	3.4%
0.50-0.35		1.0%	4.4%
0.35-0.25		2.2%	6.6%
0.25-0.18		3.0%	9.6%
0.18-0.125		7.4%	17.0%
0.125-0.088		4.9%	22.0%
0.088-0.062		2.0%	24.0%
0.062-0.031	Silt	16.3%	40.3%
0.031-0.016		23.3%	63.6%
0.016-0.008		16.7%	80.3%
0.008-0.004		1.7%	82.0%
0.004-0.002		2.9%	84.9%
0.002-0.001	Clay	2.5%	87.4%
< 0.001		12.6%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		0.2%	-



Very Coarse Sand %	1.4%		
Coarse Sand %	2.0%		
Medium Sand %	3.2%		
Fine Sand %	15.3%		
Very Fine Sand %	2.0%		
Classification:	**Silty Loam**		
Sand	24.0%		
Silt	60.9%		
Clay	15.1%		
Effective Size (mm):	10%	=	#VALUE!
	60%	=	0.0315
Uniformity Coeff. (60%/10%)		=	#VALUE!



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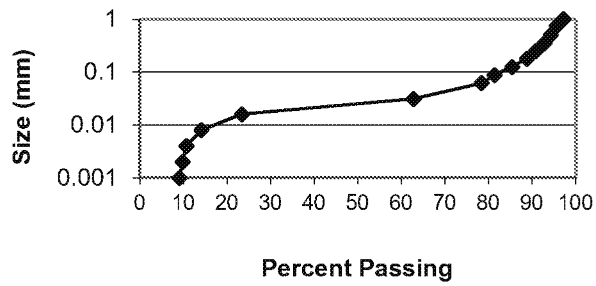
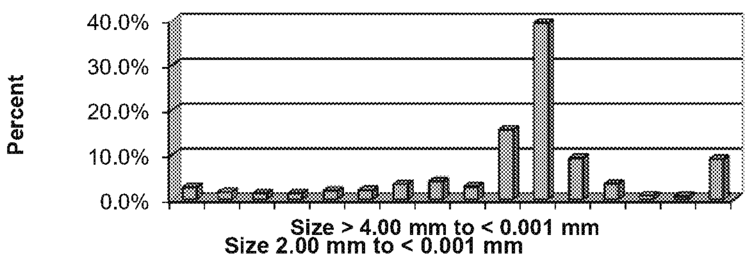
Particle Size Distribution

LABORATORY #: 6050350-18/20
IDENTIFICATION: I-2
DATE RECEIVED: May 11, 2016

*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	2.7%	2.7%
1 to 0.75		1.7%	4.4%
0.75-0.50		1.4%	5.8%
0.50-0.35		1.4%	7.2%
0.35-0.25		2.0%	9.1%
0.25-0.18		2.1%	11.2%
0.18-0.125		3.4%	14.6%
0.125-0.088		4.1%	18.7%
0.088-0.062		2.9%	21.6%
0.062-0.031	Silt	15.6%	37.2%
0.031-0.016		39.4%	76.6%
0.016-0.008		9.3%	85.9%
0.008-0.004		3.5%	89.3%
0.004-0.002		0.9%	90.2%
0.002-0.001	Clay	0.7%	90.9%
< 0.001		9.1%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		1.4%	-



Very Coarse Sand %	2.7%			
Coarse Sand %	3.0%			
Medium Sand %	3.3%			
Fine Sand %	9.6%			
Very Fine Sand %	2.9%			
Classification:	**Silty Loam**			
Sand	21.6%			
Silt	68.6%			
Clay	9.8%			
Effective Size (mm):		10%	=	0.0025
		60%	=	0.0299
Uniformity Coeff. (60%/10%)			=	11.98



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May 13, 2016

Particle Size Distribution

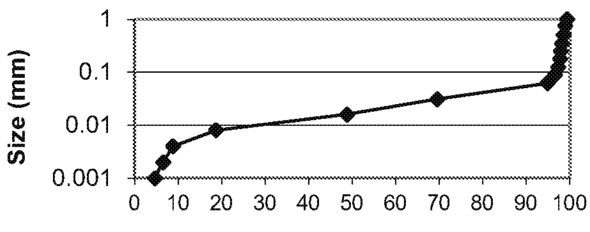
LABORATORY #: 6050350-19/20
IDENTIFICATION: J-1
DATE RECEIVED: May 11, 2016

*Gravel and stones are removed first

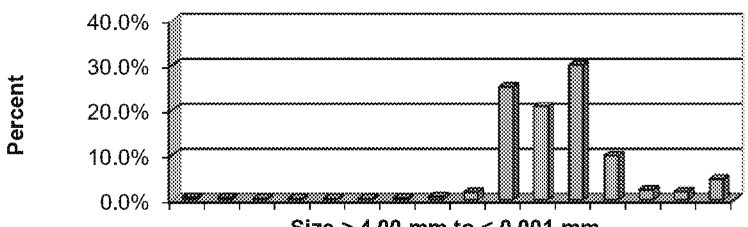
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	0.6%	0.6%
1 to 0.75		0.5%	1.1%
0.75-0.50		0.3%	1.4%
0.50-0.35		0.3%	1.7%
0.35-0.25		0.3%	2.0%
0.25-0.18		0.3%	2.3%
0.18-0.125		0.4%	2.7%
0.125-0.088		0.7%	3.4%
0.088-0.062		1.7%	5.2%
0.062-0.031	Silt	25.2%	30.4%
0.031-0.016		20.8%	51.2%
0.016-0.008		30.1%	81.3%
0.008-0.004		9.8%	91.2%
0.004-0.002		2.3%	93.5%
0.002-0.001	Clay	1.9%	95.4%
< 0.001		4.6%	100.0%

*Gravel % based on whole sample (nothing removed)

Gravel		0.1%	-



Very Coarse Sand %	0.6%		
Coarse Sand %	0.9%		
Medium Sand %	0.6%		
Fine Sand %	1.4%		
Very Fine Sand %	1.7%		
Classification:	**Silt**		
Sand	5.2%		
Silt	88.3%		
Clay	6.5%		
Effective Size (mm):	10%	=	0.0045
	60%	=	0.0241
Uniformity Coeff. (60%/10%)		=	5.38



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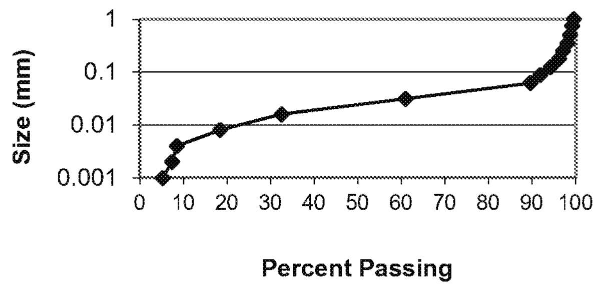
May 13, 2016

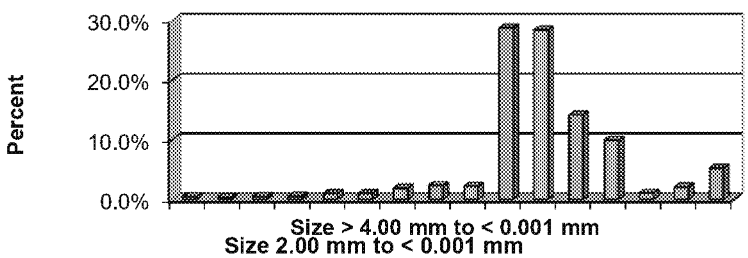
Particle Size Distribution

LABORATORY #: 6050350-20/20
IDENTIFICATION: J-2
DATE RECEIVED: May 11, 2016

*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	0.5%	0.5%
1 to 0.75		0.4%	0.8%
0.75-0.50		0.5%	1.4%
0.50-0.35		0.5%	1.9%
0.35-0.25		1.0%	2.9%
0.25-0.18		1.0%	3.9%
0.18-0.125		1.9%	5.8%
0.125-0.088		2.4%	8.2%
0.088-0.062		2.2%	10.4%
0.062-0.031	Silt	28.7%	39.1%
0.031-0.016		28.4%	67.5%
0.016-0.008		14.2%	81.6%
0.008-0.004		9.9%	91.6%
0.004-0.002		1.1%	92.6%
0.002-0.001	Clay	2.1%	94.8%
< 0.001		5.2%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		0.0%	-



Very Coarse Sand %	0.5%		
Coarse Sand %	0.9%		
Medium Sand %	1.5%		
Fine Sand %	5.3%		
Very Fine Sand %	2.2%		
Classification:	**Silt**		
Sand	10.4%		
Silt	82.3%		
Clay	7.4%		
Effective Size (mm):	10%	=	0.0046
	60%	=	0.0305
Uniformity Coeff. (60%/10%)		=	6.58



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Work Order #: 6050701
Account #: 8350
Date Received: May 24, 2016
Date Reported: May 25, 2016

Soil Report

Jodi McGraw Consulting
P.O. Box 221
Freedom, CA 95019
Attn: Jodi McGraw

Lab Number: 6050701-1/13
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: SMG-0

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	3.8	10-50	Low
Nitrate (NO_3-N)	14	20-100	Low
Total Available N	18	75-150	Low
Phosphorous(P_2O_5)	79	100-300	Low
Potassium (K_2O)	280	450-750	Low
Calcium (Ca)	2900	2066-2583	High
Magnesium (Mg)	250	300-600	Low
Sulfate (SO_4-S)	16	100-200	Low
Sodium (Na)	14	< 250	See SAR
Chloride (Cl)	12	1-100	OK
ECe (dS/m)	0.33	0.2-4	OK
Copper (Cu)	1.3	1 +	OK
Zinc (Zn)	0.90	3 +	Low
Iron (Fe)	25	8 +	OK
Manganese (Mn)	3.1	4 +	Low
Boron (B)	0.32	1-4	Low
SAR	0.27	0-6	OK
CEC (meq/100gms)	8.6	10-20	OK
ESP (%)	0.34	0-10	OK
pHs Value	5.9	6.5-7.5	Low
Organic Matter (%)	1.4		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
200	Phosphorous (P_2O_5)
300	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
3000	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep
needed to raise pH of soil to:

pH 6.0 needs	0.1
pH 6.5 needs	0.6
pH 7.0 needs	1.1

Gypsum Requirement (needed for clay treatment)
1.2 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	7.1	mg/Kg	KCl
NH_3-N	1.9	mg/Kg	KCl
P	18	mg/Kg	Olsen
SP	46	%	Sat
pHs	5.9	unit	Sat
ECe	0.33	dS/m	Sat
Ca	2.5	meq/L	Sat
Mg	1.3	meq/L	Sat
Na	0.38	meq/L	Sat
K	0.45	meq/L	Sat
Cl	0.35	meq/L	Sat
SO_4-S	0.53	meq/L	Sat
SAR	0.27	ratio	Calc
B	0.16	mg/Kg	CaCl2
Cu	0.67	mg/Kg	DTPA
Zn	0.45	mg/Kg	DTPA
Fe	13	mg/Kg	DTPA
Mn	1.6	mg/Kg	DTPA

Data:			Method
OrgMat	1.4	%	WalkBk
Org-C	0.81	%	WalkBk
SMP Bufffer pH	7.20	unit	SMP
GypReq	1.4	meq/100g	GypSol
Ca	1400	mg/Kg	NH_4OAc
Mg	120	mg/Kg	NH_4OAc
Na	6.8	mg/Kg	NH_4OAc
K	120	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	8.6	meq/100gm	Calc.
NH_3-N	0.2	% of CEC	Calc.
Ca	84.0	% of CEC	Calc.
Mg	12.1	% of CEC	Calc.
Na	0.3	% of CEC	Calc.
K	3.4	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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Work Order #: 6050701
Account #: 8350
Date Received: May 24, 2016
Date Reported: May 25, 2016

Soil Report

Jodi McGraw Consulting
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Attn: Jodi McGraw

Lab Number: 6050701-2/13
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: O-1

	Your Values (lbs/acre 6" deep)	Suggested Values
Ammonia (NH_3-N)	6.7	10-50 Low
Nitrate (NO_3-N)	49	20-100 OK
Total Available N	56	75-150 Low
Phosphorous(P_2O_5)	110	100-300 OK
Potassium (K_2O)	580	450-750 OK
Calcium (Ca)	4100	2936-3670 High
Magnesium (Mg)	320	300-600 OK
Sulfate (SO_4-S)	1100	100-200 High
Sodium (Na)	28	< 250 See SAR
Chloride (Cl)	91	1-100 OK
ECe (dS/m)	2.4	0.2-4 OK
Copper (Cu)	2.0	1 + OK
Zinc (Zn)	1.2	3 + Low
Iron (Fe)	20	8 + OK
Manganese (Mn)	4.9	4 + OK
Boron (B)	1.5	1-4 OK
SAR	0.29	0-6 OK
CEC (meq/100gms)	12	10-20 OK
ESP (%)	0.50	0-10 OK
pHs Value	6.5	6.5-7.5 OK
Organic Matter (%)	3.2	

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

75	Nitrogen (N)
150	Phosphorous (P_2O_5)
100	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
2000	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.6

Gypsum Requirement (needed for clay treatment)
0.6 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	25	mg/Kg	KCl
NH_3-N	3.4	mg/Kg	KCl
P	26	mg/Kg	Olsen
SP	67	%	Sat
pHs	6.5	unit	Sat
ECe	2.4	dS/m	Sat
Ca	26	meq/L	Sat
Mg	4.5	meq/L	Sat
Na	1.2	meq/L	Sat
K	1.6	meq/L	Sat
Cl	1.9	meq/L	Sat
SO_4-S	25	meq/L	Sat
SAR	0.29	ratio	Calc
B	0.73	mg/Kg	CaCl2
Cu	1.0	mg/Kg	DTPA
Zn	0.58	mg/Kg	DTPA
Fe	10	mg/Kg	DTPA
Mn	2.4	mg/Kg	DTPA

Data:			Method
OrgMat	3.2	%	WalkBk
Org-C	1.8	%	WalkBk
SMP Bufffer pH	7.23	unit	SMP
GypReq	0.74	meq/100g	GypSol
Ca	2000	mg/Kg	NH_4OAc
Mg	160	mg/Kg	NH_4OAc
Na	14	mg/Kg	NH_4OAc
K	240	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	12	meq/100gm	Calc.
NH_3-N	0.2	% of CEC	Calc.
Ca	83.5	% of CEC	Calc.
Mg	10.8	% of CEC	Calc.
Na	0.5	% of CEC	Calc.
K	5.0	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

ANALYTICAL CHEMISTS and BACTERIOLOGISTS Approved by State of California

SOIL CONTROL LAB

42 HANGAR WAY WATSONVILLE CALIFORNIA 95076 USA

TEL: 831-724-5422
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Work Order #: 6050701
Account #: 8350
Date Received: May 24, 2016
Date Reported: May 25, 2016

Soil Report

Jodi McGraw Consulting
P.O. Box 221
Freedom, CA 95019
Attn: Jodi McGraw

Lab Number: 6050701-3/13
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: P-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	7.0	10-50	Low
Nitrate (NO_3-N)	37	20-100	OK
Total Available N	44	75-150	Low
Phosphorous(P_2O_5)	61	100-300	Low
Potassium (K_2O)	430	450-750	Low
Calcium (Ca)	3300	2537-3172	High
Magnesium (Mg)	400	300-600	OK
Sulfate (SO_4-S)	110	100-200	OK
Sodium (Na)	33	< 250	See SAR
Chloride (Cl)	50	1-100	OK
ECe (dS/m)	0.88	0.2-4	OK
Copper (Cu)	1.6	1 +	OK
Zinc (Zn)	0.47	3 +	Low
Iron (Fe)	23	8 +	OK
Manganese (Mn)	5.8	4 +	OK
Boron (B)	0.92	1-4	Low
SAR	0.48	0-6	OK
CEC (meq/100gms)	11	10-20	OK
ESP (%)	0.68	0-10	OK
pHs Value	6.4	6.5-7.5	Low
Organic Matter (%)	1.8		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

100	Nitrogen (N)
200	Phosphorous (P_2O_5)
150	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
2000	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.1
pH 7.0 needs	0.6

Gypsum Requirement (needed for clay treatment)
1.5 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	18	mg/Kg	KCl
NH_3-N	3.5	mg/Kg	KCl
P	14	mg/Kg	Olsen
SP	65	%	Sat
pHs	6.4	unit	Sat
ECe	0.88	dS/m	Sat
Ca	5.2	meq/L	Sat
Mg	1.8	meq/L	Sat
Na	0.89	meq/L	Sat
K	0.73	meq/L	Sat
Cl	1.1	meq/L	Sat
SO_4-S	2.6	meq/L	Sat
SAR	0.48	ratio	Calc
B	0.46	mg/Kg	CaCl2
Cu	0.81	mg/Kg	DTPA
Zn	0.24	mg/Kg	DTPA
Fe	11	mg/Kg	DTPA
Mn	2.9	mg/Kg	DTPA

Data:			Method
OrgMat	1.8	%	WalkBk
Org-C	1.1	%	WalkBk
SMP Bufffer pH	7.16	unit	SMP
GypReq	1.7	meq/100g	GypSol
Ca	1700	mg/Kg	NH_4OAc
Mg	200	mg/Kg	NH_4OAc
Na	17	mg/Kg	NH_4OAc
K	180	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	11	meq/100gm	Calc.
NH_3-N	0.2	% of CEC	Calc.
Ca	79.0	% of CEC	Calc.
Mg	15.7	% of CEC	Calc.
Na	0.7	% of CEC	Calc.
K	4.3	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

42 HANGAR WAY
WATSONVILLE
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Work Order #: 6050701
Account #: 8350
Date Received: May 24, 2016
Date Reported: May 25, 2016

Soil Report

Jodi McGraw Consulting
P.O. Box 221
Freedom, CA 95019
Attn: Jodi McGraw

Lab Number: 6050701-4/13
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: P-2

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	6.2	10-50	Low
Nitrate (NO_3-N)	28	20-100	OK
Total Available N	35	75-150	Low
Phosphorous(P_2O_5)	51	100-300	Low
Potassium (K_2O)	370	450-750	Low
Calcium (Ca)	4200	2874-3593	High
Magnesium (Mg)	270	300-600	Low
Sulfate (SO_4-S)	35	100-200	Low
Sodium (Na)	17	< 250	See SAR
Chloride (Cl)	23	1-100	OK
ECe (dS/m)	0.66	0.2-4	OK
Copper (Cu)	0.97	1 +	Low
Zinc (Zn)	0.27	3 +	Low
Iron (Fe)	17	8 +	OK
Manganese (Mn)	3.1	4 +	Low
Boron (B)	1.1	1-4	OK
SAR	0.29	0-6	OK
CEC (meq/100gms)	12	10-20	OK
ESP (%)	0.30	0-10	OK
pHs Value	6.9	6.5-7.5	OK
Organic Matter (%)	2.1		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

100	Nitrogen (N)
200	Phosphorous (P_2O_5)
200	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.1

Gypsum Requirement (needed for clay treatment)
1.0 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	14	mg/Kg	KCl
NH_3-N	3.1	mg/Kg	KCl
P	12	mg/Kg	Olsen
SP	66	%	Sat
pHs	6.9	unit	Sat
ECe	0.66	dS/m	Sat
Ca	5.7	meq/L	Sat
Mg	1.0	meq/L	Sat
Na	0.53	meq/L	Sat
K	0.45	meq/L	Sat
Cl	0.49	meq/L	Sat
SO_4-S	0.84	meq/L	Sat
SAR	0.29	ratio	Calc
B	0.54	mg/Kg	CaCl2
Cu	0.48	mg/Kg	DTPA
Zn	0.14	mg/Kg	DTPA
Fe	8.5	mg/Kg	DTPA
Mn	1.6	mg/Kg	DTPA

Data:			Method
OrgMat	2.1	%	WalkBk
Org-C	1.2	%	WalkBk
SMP Bufffer pH	7.29	unit	SMP
GypReq	1.1	meq/100g	GypSol
Ca	2100	mg/Kg	NH_4OAc
Mg	140	mg/Kg	NH_4OAc
Na	8.3	mg/Kg	NH_4OAc
K	150	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	12	meq/100gm	Calc.
NH_3-N	0.2	% of CEC	Calc.
Ca	86.8	% of CEC	Calc.
Mg	9.4	% of CEC	Calc.
Na	0.3	% of CEC	Calc.
K	3.3	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB
42 HANGAR WAY WATSONVILLE CALIFORNIA 95076 USA
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Work Order #: 6050701
Account #: 8350
Date Received: May 24, 2016
Date Reported: May 25, 2016

Soil Report

Jodi McGraw Consulting
P.O. Box 221
Freedom, CA 95019
Attn: Jodi McGraw

Lab Number: 6050701-5/13
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: Q-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	5.7	10-50	Low
Nitrate (NO_3-N)	21	20-100	OK
Total Available N	27	75-150	Low
Phosphorous(P_2O_5)	49	100-300	Low
Potassium (K_2O)	320	450-750	Low
Calcium (Ca)	4600	3089-3861	High
Magnesium (Mg)	210	308-617	Low
Sulfate (SO_4-S)	30	100-200	Low
Sodium (Na)	26	< 250	See SAR
Chloride (Cl)	20	1-100	OK
ECe (dS/m)	0.54	0.2-4	OK
Copper (Cu)	1.2	1 +	OK
Zinc (Zn)	0.24	3 +	Low
Iron (Fe)	16	8 +	OK
Manganese (Mn)	1.8	4 +	Low
Boron (B)	1.2	1-4	OK
SAR	0.37	0-6	OK
CEC (meq/100gms)	13	10-20	OK
ESP (%)	0.44	0-10	OK
pHs Value	7.1	6.5-7.5	OK
Organic Matter (%)	1.4		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

100	Nitrogen (N)
250	Phosphorous (P_2O_5)
250	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.0

Gypsum Requirement (needed for clay treatment)
0.6 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	10	mg/Kg	KCl
NH_3-N	2.8	mg/Kg	KCl
P	11	mg/Kg	Olsen
SP	65	%	Sat
pHs	7.1	unit	Sat
ECe	0.54	dS/m	Sat
Ca	4.9	meq/L	Sat
Mg	1.0	meq/L	Sat
Na	0.64	meq/L	Sat
K	0.38	meq/L	Sat
Cl	0.44	meq/L	Sat
SO_4-S	0.72	meq/L	Sat
SAR	0.37	ratio	Calc
B	0.58	mg/Kg	CaCl2
Cu	0.62	mg/Kg	DTPA
Zn	0.12	mg/Kg	DTPA
Fe	8.0	mg/Kg	DTPA
Mn	0.91	mg/Kg	DTPA

Data:			Method
OrgMat	1.4	%	WalkBk
Org-C	0.83	%	WalkBk
SMP Bufffer pH	7.33	unit	SMP
GypReq	0.69	meq/100g	GypSol
Ca	2300	mg/Kg	NH_4OAc
Mg	100	mg/Kg	NH_4OAc
Na	13	mg/Kg	NH_4OAc
K	130	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	13	meq/100gm	Calc.
NH_3-N	0.2	% of CEC	Calc.
Ca	90.0	% of CEC	Calc.
Mg	6.8	% of CEC	Calc.
Na	0.4	% of CEC	Calc.
K	2.7	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

42 HANGAR WAY WATSONVILLE CALIFORNIA 95076 USA

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Work Order #: 6050701
Account #: 8350
Date Received: May 24, 2016
Date Reported: May 25, 2016

Soil Report

Jodi McGraw Consulting
P.O. Box 221
Freedom, CA 95019
Attn: Jodi McGraw

Lab Number: 6050701-6/13
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: R-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	9.8	10-50	Low
Nitrate (NO_3-N)	17	20-100	Low
Total Available N	27	75-150	Low
Phosphorous(P_2O_5)	74	100-300	Low
Potassium (K_2O)	390	450-750	Low
Calcium (Ca)	2400	2948-3685	Low
Magnesium (Mg)	1100	300-600	High
Sulfate (SO_4-S)	45	100-200	Low
Sodium (Na)	530	< 250	See SAR
Chloride (Cl)	210	1-100	High
ECe (dS/m)	1.0	0.2-4	OK
Copper (Cu)	1.5	1 +	OK
Zinc (Zn)	1.1	3 +	Low
Iron (Fe)	44	8 +	OK
Manganese (Mn)	17	4 +	OK
Boron (B)	0.75	1-4	Low
SAR	4.1	0-6	OK
CEC (meq/100gms)	12	10-20	OK
ESP (%)	9.4	0-10	OK
pHs Value	6.0	6.5-7.5	Low
Organic Matter (%)	2.4		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

100	Nitrogen (N)
200	Phosphorous (P_2O_5)
200	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
3000	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.0

Gypsum Requirement (needed for clay treatment)
3.7 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	8.4	mg/Kg	KCl
NH_3-N	4.9	mg/Kg	KCl
P	17	mg/Kg	Olsen
SP	53	%	Sat
pHs	6.0	unit	Sat
ECe	1.0	dS/m	Sat
Ca	3.3	meq/L	Sat
Mg	3.3	meq/L	Sat
Na	7.5	meq/L	Sat
K	0.45	meq/L	Sat
Cl	5.5	meq/L	Sat
SO_4-S	1.3	meq/L	Sat
SAR	4.1	ratio	Calc
B	0.37	mg/Kg	CaCl2
Cu	0.77	mg/Kg	DTPA
Zn	0.56	mg/Kg	DTPA
Fe	22	mg/Kg	DTPA
Mn	8.3	mg/Kg	DTPA

Data:			Method
OrgMat	2.4	%	WalkBk
Org-C	1.4	%	WalkBk
SMP Bufffer pH	6.93	unit	SMP
GypReq	4.4	meq/100g	GypSol
Ca	1200	mg/Kg	NH_4OAc
Mg	560	mg/Kg	NH_4OAc
Na	260	mg/Kg	NH_4OAc
K	160	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	12	meq/100gm	Calc.
NH_3-N	0.3	% of CEC	Calc.
Ca	48.8	% of CEC	Calc.
Mg	38.2	% of CEC	Calc.
Na	9.4	% of CEC	Calc.
K	3.3	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

42 HANGAR WAY WATSONVILLE CALIFORNIA 95076 USA

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Work Order #: 6050701
Account #: 8350
Date Received: May 24, 2016
Date Reported: May 25, 2016

Soil Report

Jodi McGraw Consulting
P.O. Box 221
Freedom, CA 95019
Attn: Jodi McGraw

Lab Number: 6050701-7/13
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: R-2

	Your Values (lbs/acre 6" deep)	Suggested Values
Ammonia (NH_3-N)	2.6	10-50 Low
Nitrate (NO_3-N)	8.7	20-100 Low
Total Available N	11	75-150 Low
Phosphorous(P_2O_5)	180	100-300 OK
Potassium (K_2O)	400	450-750 Low
Calcium (Ca)	1900	2000-2500 Low
Magnesium (Mg)	260	300-600 Low
Sulfate (SO_4-S)	13	100-200 Low
Sodium (Na)	26	< 250 See SAR
Chloride (Cl)	28	1-100 OK
ECe (dS/m)	0.39	0.2-4 OK
Copper (Cu)	0.83	1 + Low
Zinc (Zn)	1.4	3 + Low
Iron (Fe)	55	8 + OK
Manganese (Mn)	8.5	4 + OK
Boron (B)	0.40	1-4 Low
SAR	0.89	0-6 OK
CEC (meq/100gms)	6.2	10-20 OK
ESP (%)	0.92	0-10 OK
pHs Value	5.9	6.5-7.5 Low
Organic Matter (%)	1.8	

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
100	Phosphorous (P_2O_5)
150	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
2000	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.1
pH 6.5 needs	0.6
pH 7.0 needs	1.1

Gypsum Requirement (needed for clay treatment)
1.5 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	4.3	mg/Kg	KCl
NH_3-N	1.3	mg/Kg	KCl
P	42	mg/Kg	Olsen
SP	38	%	Sat
pHs	5.9	unit	Sat
ECe	0.39	dS/m	Sat
Ca	4.2	meq/L	Sat
Mg	2.6	meq/L	Sat
Na	1.6	meq/L	Sat
K	0.33	meq/L	Sat
Cl	1.0	meq/L	Sat
SO_4-S	0.54	meq/L	Sat
SAR	0.89	ratio	Calc
B	0.20	mg/Kg	CaCl2
Cu	0.42	mg/Kg	DTPA
Zn	0.71	mg/Kg	DTPA
Fe	28	mg/Kg	DTPA
Mn	4.3	mg/Kg	DTPA

Data:			Method
OrgMat	1.8	%	WalkBk
Org-C	1.0	%	WalkBk
SMP Bufffer pH	7.13	unit	SMP
GypReq	1.8	meq/100g	GypSol
Ca	930	mg/Kg	NH_4OAc
Mg	130	mg/Kg	NH_4OAc
Na	13	mg/Kg	NH_4OAc
K	170	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	6.2	meq/100gm	Calc.
NH_3-N	0.2	% of CEC	Calc.
Ca	74.7	% of CEC	Calc.
Mg	17.3	% of CEC	Calc.
Na	0.9	% of CEC	Calc.
K	6.9	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

42 HANGAR WAY WATSONVILLE CALIFORNIA 95076 USA

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Soil Report

Jodi McGraw Consulting
P.O. Box 221
Freedom, CA 95019
Attn: Jodi McGraw

Lab Number: 6050701-8/13
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: S-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	7.0	10-50	Low
Nitrate (NO_3-N)	31	20-100	OK
Total Available N	37	75-150	Low
Phosphorous(P_2O_5)	53	100-300	Low
Potassium (K_2O)	320	450-750	Low
Calcium (Ca)	4000	3447-4309	OK
Magnesium (Mg)	940	344-689	High
Sulfate (SO_4-S)	32	100-200	Low
Sodium (Na)	84	< 250	See SAR
Chloride (Cl)	80	1-100	OK
ECe (dS/m)	0.79	0.2-4	OK
Copper (Cu)	1.3	1 +	OK
Zinc (Zn)	0.30	3 +	Low
Iron (Fe)	21	8 +	OK
Manganese (Mn)	5.9	4 +	OK
Boron (B)	0.77	1-4	Low
SAR	0.44	0-6	OK
CEC (meq/100gms)	14	10-20	OK
ESP (%)	1.3	0-10	OK
pHs Value	6.1	6.5-7.5	Low
Organic Matter (%)	1.5		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

100	Nitrogen (N)
200	Phosphorous (P_2O_5)
250	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
2000	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.4
pH 7.0 needs	0.9

Gypsum Requirement (needed for clay treatment)
2.5 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	15	mg/Kg	KCl
NH_3-N	3.5	mg/Kg	KCl
P	12	mg/Kg	Olsen
SP	63	%	Sat
pHs	6.1	unit	Sat
ECe	0.79	dS/m	Sat
Ca	4.6	meq/L	Sat
Mg	0.84	meq/L	Sat
Na	0.73	meq/L	Sat
K	0.20	meq/L	Sat
Cl	1.8	meq/L	Sat
SO_4-S	0.78	meq/L	Sat
SAR	0.44	ratio	Calc
B	0.39	mg/Kg	CaCl2
Cu	0.65	mg/Kg	DTPA
Zn	0.15	mg/Kg	DTPA
Fe	10	mg/Kg	DTPA
Mn	3.0	mg/Kg	DTPA

Data:			Method
OrgMat	1.5	%	WalkBk
Org-C	0.88	%	WalkBk
SMP Bufffer pH	7.05	unit	SMP
GypReq	2.9	meq/100g	GypSol
Ca	2000	mg/Kg	NH_4OAc
Mg	470	mg/Kg	NH_4OAc
Na	42	mg/Kg	NH_4OAc
K	130	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	14	meq/100gm	Calc.
NH_3-N	0.2	% of CEC	Calc.
Ca	68.7	% of CEC	Calc.
Mg	27.4	% of CEC	Calc.
Na	1.3	% of CEC	Calc.
K	2.4	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

42 HANGAR WAY
WATSONVILLE
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TEL: 831-724-5422
FAX: 831-724-3188

Work Order #: 6050701
Account #: 8350
Date Received: May 24, 2016
Date Reported: May 25, 2016

Soil Report

Jodi McGraw Consulting
P.O. Box 221
Freedom, CA 95019
Attn: Jodi McGraw

Lab Number: 6050701-9/13
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: S-2

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	6.7	10-50	Low
Nitrate (NO_3-N)	9.2	20-100	Low
Total Available N	16	75-150	Low
Phosphorous(P_2O_5)	62	100-300	Low
Potassium (K_2O)	340	450-750	Low
Calcium (Ca)	5300	3604-4505	High
Magnesium (Mg)	330	360-720	Low
Sulfate (SO_4-S)	24	100-200	Low
Sodium (Na)	43	< 250	See SAR
Chloride (Cl)	51	1-100	OK
ECe (dS/m)	0.57	0.2-4	OK
Copper (Cu)	0.69	1 +	Low
Zinc (Zn)	0.30	3 +	Low
Iron (Fe)	13	8 +	OK
Manganese (Mn)	2.2	4 +	Low
Boron (B)	1.0	1-4	OK
SAR	0.37	0-6	OK
CEC (meq/100gms)	15	10-20	OK
ESP (%)	0.62	0-10	OK
pHs Value	6.9	6.5-7.5	OK
Organic Matter (%)	1.8		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
200	Phosphorous (P_2O_5)
250	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep
needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.1

Gypsum Requirement (needed for clay treatment)
1.0 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	4.6	mg/Kg	KCl
NH_3-N	3.4	mg/Kg	KCl
P	14	mg/Kg	Olsen
SP	64	%	Sat
pHs	6.9	unit	Sat
ECe	0.57	dS/m	Sat
Ca	6.4	meq/L	Sat
Mg	0.93	meq/L	Sat
Na	0.71	meq/L	Sat
K	0.51	meq/L	Sat
Cl	1.1	meq/L	Sat
SO_4-S	0.58	meq/L	Sat
SAR	0.37	ratio	Calc
B	0.52	mg/Kg	CaCl2
Cu	0.34	mg/Kg	DTPA
Zn	0.15	mg/Kg	DTPA
Fe	6.4	mg/Kg	DTPA
Mn	1.1	mg/Kg	DTPA

Data:			Method
OrgMat	1.8	%	WalkBk
Org-C	1.0	%	WalkBk
SMP Bufffer pH	7.30	unit	SMP
GypReq	1.2	meq/100g	GypSol
Ca	2600	mg/Kg	NH_4OAc
Mg	170	mg/Kg	NH_4OAc
Na	21	mg/Kg	NH_4OAc
K	140	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages			
CEC	15	meq/100gm	Calc.
NH_3-N	0.2	% of CEC	Calc.
Ca	87.6	% of CEC	Calc.
Mg	9.2	% of CEC	Calc.
Na	0.6	% of CEC	Calc.
K	2.4	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

42 HANGAR WAY
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Work Order #: 6050701
Account #: 8350
Date Received: May 24, 2016
Date Reported: May 25, 2016

Soil Report

Jodi McGraw Consulting
P.O. Box 221
Freedom, CA 95019
Attn: Jodi McGraw

Lab Number: 6050701-10/13
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: S-3

	Your Values (lbs/acre 6" deep)	Suggested Values
Ammonia (NH_3-N)	8.2	10-50 Low
Nitrate (NO_3-N)	35	20-100 OK
Total Available N	43	75-150 Low
Phosphorous(P_2O_5)	59	100-300 Low
Potassium (K_2O)	520	477-796 OK
Calcium (Ca)	6000	4069-5087 High
Magnesium (Mg)	290	406-813 Low
Sulfate (SO_4-S)	49	100-200 Low
Sodium (Na)	36	< 250 See SAR
Chloride (Cl)	47	1-100 OK
ECe (dS/m)	0.78	0.2-4 OK
Copper (Cu)	1.1	1 + OK
Zinc (Zn)	0.32	3 + Low
Iron (Fe)	12	8 + OK
Manganese (Mn)	1.6	4 + Low
Boron (B)	1.2	1-4 OK
SAR	0.34	0-6 OK
CEC (meq/100gms)	17	10-20 OK
ESP (%)	0.46	0-10 OK
pHs Value	7.0	6.5-7.5 OK
Organic Matter (%)	1.9	

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

100 Nitrogen (N)
200 Phosphorous (P_2O_5)
100 Potassium (K_2O)
0 Gypsum ($CaSO_4$)
0 Lime ($CaCO_3$)
0 Dolomite ($CaCO_3$ & $MgCO_3$)
0 Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs 0.0
pH 6.5 needs 0.0
pH 7.0 needs 0.0

Gypsum Requirement (needed for clay treatment)
0.6 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	18	mg/Kg	KCl
NH_3-N	4.1	mg/Kg	KCl
P	13	mg/Kg	Olsen
SP	71	%	Sat
pHs	7.0	unit	Sat
ECe	0.78	dS/m	Sat
Ca	3.6	meq/L	Sat
Mg	0.72	meq/L	Sat
Na	0.49	meq/L	Sat
K	0.19	meq/L	Sat
Cl	0.93	meq/L	Sat
SO_4-S	1.1	meq/L	Sat
SAR	0.34	ratio	Calc
B	0.61	mg/Kg	CaCl2
Cu	0.56	mg/Kg	DTPA
Zn	0.16	mg/Kg	DTPA
Fe	6.0	mg/Kg	DTPA
Mn	0.82	mg/Kg	DTPA

Data:			Method
OrgMat	1.9	%	WalkBk
Org-C	1.1	%	WalkBk
SMP Bufffer pH	7.37	unit	SMP
GypReq	0.76	meq/100g	GypSol
Ca	3000	mg/Kg	NH_4OAc
Mg	150	mg/Kg	NH_4OAc
Na	18	mg/Kg	NH_4OAc
K	220	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages			
CEC	17	meq/100gm	Calc.
NH_3-N	0.2	% of CEC	Calc.
Ca	88.9	% of CEC	Calc.
Mg	7.2	% of CEC	Calc.
Na	0.5	% of CEC	Calc.
K	3.3	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

42 HANGAR WAY WATSONVILLE CALIFORNIA 95076 USA

TEL: 831-724-5422
FAX: 831-724-3188

Work Order #: 6050701
Account #: 8350
Date Received: May 24, 2016
Date Reported: May 25, 2016

Soil Report

Jodi McGraw Consulting
P.O. Box 221
Freedom, CA 95019
Attn: Jodi McGraw

Lab Number: 6050701-11/13
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: T-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	9.0	10-50	Low
Nitrate (NO_3-N)	12	20-100	Low
Total Available N	21	75-150	Low
Phosphorous(P_2O_5)	69	100-300	Low
Potassium (K_2O)	580	605-1009	Low
Calcium (Ca)	7300	5157-6446	High
Magnesium (Mg)	620	515-1031	OK
Sulfate (SO_4-S)	24	100-200	Low
Sodium (Na)	41	< 250	See SAR
Chloride (Cl)	27	1-100	OK
ECe (dS/m)	0.50	0.2-4	OK
Copper (Cu)	0.91	1 +	Low
Zinc (Zn)	0.35	3 +	Low
Iron (Fe)	15	8 +	OK
Manganese (Mn)	2.5	4 +	Low
Boron (B)	1.0	1-4	OK
SAR	0.63	0-6	OK
CEC (meq/100gms)	21	10-20	OK
ESP (%)	0.42	0-10	OK
pHs Value	6.9	6.5-7.5	OK
Organic Matter (%)	2.2		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
200	Phosphorous (P_2O_5)
200	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.2

Gypsum Requirement (needed for clay treatment)
1.5 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	5.9	mg/Kg	KCl
NH_3-N	4.5	mg/Kg	KCl
P	16	mg/Kg	Olsen
SP	65	%	Sat
pHs	6.9	unit	Sat
ECe	0.50	dS/m	Sat
Ca	3.1	meq/L	Sat
Mg	2.8	meq/L	Sat
Na	1.1	meq/L	Sat
K	0.53	meq/L	Sat
Cl	0.58	meq/L	Sat
SO_4-S	0.58	meq/L	Sat
SAR	0.63	ratio	Calc
B	0.52	mg/Kg	CaCl2
Cu	0.45	mg/Kg	DTPA
Zn	0.18	mg/Kg	DTPA
Fe	7.7	mg/Kg	DTPA
Mn	1.3	mg/Kg	DTPA

Data:			Method
OrgMat	2.2	%	WalkBk
Org-C	1.3	%	WalkBk
SMP Bufffer pH	7.17	unit	SMP
GypReq	1.7	meq/100g	GypSol
Ca	3600	mg/Kg	NH_4OAc
Mg	310	mg/Kg	NH_4OAc
Na	21	mg/Kg	NH_4OAc
K	240	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	21	meq/100gm	Calc.
NH_3-N	0.2	% of CEC	Calc.
Ca	84.5	% of CEC	Calc.
Mg	12.0	% of CEC	Calc.
Na	0.4	% of CEC	Calc.
K	2.9	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

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Work Order #: 6050701
Account #: 8350
Date Received: May 24, 2016
Date Reported: May 25, 2016

Soil Report

Jodi McGraw Consulting
P.O. Box 221
Freedom, CA 95019
Attn: Jodi McGraw

Lab Number: 6050701-12/13
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: T-2

	Your Values (lbs/acre 6" deep)	Suggested Values
Ammonia (NH_3-N)	6.2	10-50 Low
Nitrate (NO_3-N)	41	20-100 OK
Total Available N	48	75-150 Low
Phosphorous(P_2O_5)	53	100-300 Low
Potassium (K_2O)	780	537-896 OK
Calcium (Ca)	4500	4582-5727 Low
Magnesium (Mg)	1700	458-916 High
Sulfate (SO_4-S)	34	100-200 Low
Sodium (Na)	82	< 250 See SAR
Chloride (Cl)	42	1-100 OK
ECe (dS/m)	0.67	0.2-4 OK
Copper (Cu)	1.6	1 + OK
Zinc (Zn)	0.39	3 + Low
Iron (Fe)	29	8 + OK
Manganese (Mn)	8.1	4 + OK
Boron (B)	1.1	1-4 OK
SAR	0.36	0-6 OK
CEC (meq/100gms)	19	10-20 OK
ESP (%)	0.93	0-10 OK
pHs Value	6.4	6.5-7.5 Low
Organic Matter (%)	1.9	

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

100	Nitrogen (N)
200	Phosphorous (P_2O_5)
0	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
2000	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.1
pH 7.0 needs	0.6

Gypsum Requirement (needed for clay treatment)
3.3 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	21	mg/Kg	KCl
NH_3-N	3.1	mg/Kg	KCl
P	12	mg/Kg	Olsen
SP	72	%	Sat
pHs	6.4	unit	Sat
ECe	0.67	dS/m	Sat
Ca	3.5	meq/L	Sat
Mg	2.2	meq/L	Sat
Na	0.61	meq/L	Sat
K	0.73	meq/L	Sat
Cl	0.82	meq/L	Sat
SO_4-S	0.73	meq/L	Sat
SAR	0.36	ratio	Calc
B	0.56	mg/Kg	CaCl2
Cu	0.78	mg/Kg	DTPA
Zn	0.20	mg/Kg	DTPA
Fe	15	mg/Kg	DTPA
Mn	4.0	mg/Kg	DTPA

Data:			Method
OrgMat	1.9	%	WalkBk
Org-C	1.1	%	WalkBk
SMP Bufffer pH	6.96	unit	SMP
GypReq	3.9	meq/100g	GypSol
Ca	2200	mg/Kg	NH_4OAc
Mg	830	mg/Kg	NH_4OAc
Na	41	mg/Kg	NH_4OAc
K	320	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	19	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	58.4	% of CEC	Calc.
Mg	36.2	% of CEC	Calc.
Na	0.9	% of CEC	Calc.
K	4.4	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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Work Order #: 6050701
Account #: 8350
Date Received: May 24, 2016
Date Reported: May 25, 2016

Soil Report

Jodi McGraw Consulting
P.O. Box 221
Freedom, CA 95019
Attn: Jodi McGraw

Lab Number: 6050701-13/13
Project #/Name: 3738 / Newhall- Spineflower
Sample ID: U-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	15	10-50	OK
Nitrate (NO_3-N)	12	20-100	Low
Total Available N	27	75-150	Low
Phosphorous(P_2O_5)	80	100-300	Low
Potassium (K_2O)	480	450-750	OK
Calcium (Ca)	4700	3593-4492	High
Magnesium (Mg)	610	359-718	OK
Sulfate (SO_4-S)	32	100-200	Low
Sodium (Na)	40	< 250	See SAR
Chloride (Cl)	40	1-100	OK
ECe (dS/m)	0.44	0.2-4	OK
Copper (Cu)	1.5	1 +	OK
Zinc (Zn)	0.88	3 +	Low
Iron (Fe)	26	8 +	OK
Manganese (Mn)	7.4	4 +	OK
Boron (B)	0.89	1-4	Low
SAR	3.5	0-6	OK
CEC (meq/100gms)	15	10-20	OK
ESP (%)	0.59	0-10	OK
pHs Value	6.3	6.5-7.5	Low
Organic Matter (%)	2.7		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

100	Nitrogen (N)
200	Phosphorous (P_2O_5)
100	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
2000	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep
needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.2
pH 7.0 needs	0.7

Gypsum Requirement (needed for clay treatment)
1.7 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	6.0	mg/Kg	KCl
NH_3-N	7.3	mg/Kg	KCl
P	18	mg/Kg	Olsen
SP	74	%	Sat
pHs	6.3	unit	Sat
ECe	0.44	dS/m	Sat
Ca	2.2	meq/L	Sat
Mg	1.3	meq/L	Sat
Na	4.6	meq/L	Sat
K	0.18	meq/L	Sat
Cl	0.77	meq/L	Sat
SO_4-S	0.69	meq/L	Sat
SAR	3.5	ratio	Calc
B	0.45	mg/Kg	CaCl2
Cu	0.73	mg/Kg	DTPA
Zn	0.44	mg/Kg	DTPA
Fe	13	mg/Kg	DTPA
Mn	3.7	mg/Kg	DTPA

Data:			Method
OrgMat	2.7	%	WalkBk
Org-C	1.6	%	WalkBk
SMP Bufffer pH	7.02	unit	SMP
GypReq	2.0	meq/100g	GypSol
Ca	2400	mg/Kg	NH_4OAc
Mg	310	mg/Kg	NH_4OAc
Na	20	mg/Kg	NH_4OAc
K	200	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	15	meq/100gm	Calc.
NH_3-N	0.3	% of CEC	Calc.
Ca	78.5	% of CEC	Calc.
Mg	17.1	% of CEC	Calc.
Na	0.6	% of CEC	Calc.
K	3.4	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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Work Order #: 7040688
Account #: 9690
Date Received: Apr 21, 2017
Date Reported: Apr 24, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040688-1/10
Project #/Name: None / Newhall
Sample ID: PR 15 1-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	4.6	10-50	Low
Nitrate (NO_3-N)	10	20-100	Low
Total Available N	15	75-150	Low
Phosphorous(P_2O_5)	120	100-300	OK
Potassium (K_2O)	500	450-750	OK
Calcium (Ca)	2200	2000-2500	OK
Magnesium (Mg)	290	300-600	Low
Sulfate (SO_4-S)	4.9	100-200	Low
Sodium (Na)	6.4	< 250	See SAR
Chloride (Cl)	2.6	1-100	OK
ECe (dS/m)	0.17	0.2-4	Low
Copper (Cu)	1.3	1 +	OK
Zinc (Zn)	1.3	3 +	Low
Iron (Fe)	75	8 +	OK
Manganese (Mn)	16	4 +	OK
Boron (B)	0.50	1-4	Low
SAR	0.084	0-6	OK
CEC (meq/100gms)	7.4	10-20	OK
ESP (%)	0.19	0-10	OK
pHs Value	5.8	6.5-7.5	Low
Organic Matter (%)	2.0		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
150	Phosphorous (P_2O_5)
200	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
2000	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep
needed to raise pH of soil to:

pH 6.0 needs	1.4
pH 6.5 needs	1.7
pH 7.0 needs	2.0

Gypsum Requirement (needed for clay treatment)
1.0 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	5.1	mg/Kg	KCl
NH_3-N	2.3	mg/Kg	KCl
P	28	mg/Kg	Olsen
SP	28	%	Sat
pHs	5.8	unit	Sat
ECe	0.17	dS/m	Sat
Ca	3.6	meq/L	Sat
Mg	1.1	meq/L	Sat
Na	0.13	meq/L	Sat
K	0.74	meq/L	Sat
Cl	0.13	meq/L	Sat
SO_4-S	0.28	meq/L	Sat
SAR	0.084	ratio	Calc
B	0.25	mg/Kg	CaCl2
Cu	0.63	mg/Kg	DTPA
Zn	0.66	mg/Kg	DTPA
Fe	38	mg/Kg	DTPA
Mn	8.2	mg/Kg	DTPA

Data:			Method
OrgMat	2.0	%	WalkBk
Org-C	1.2	%	WalkBk
SMP Bufffer pH	6.74	unit	SMP
GypReq	1.2	meq/100g	GypSol
Ca	1100	mg/Kg	NH_4OAc
Mg	140	mg/Kg	NH_4OAc
Na	3.2	mg/Kg	NH_4OAc
K	210	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	7.4	meq/100gm	Calc.
NH_3-N	0.2	% of CEC	Calc.
Ca	76.2	% of CEC	Calc.
Mg	16.3	% of CEC	Calc.
Na	0.2	% of CEC	Calc.
K	7.2	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

42 HANGAR WAY
WATSONVILLE
CALIFORNIA
95076
USA

TEL: 831-724-5422
FAX: 831-724-3188

Work Order #: 7040688
Account #: 9690
Date Received: Apr 21, 2017
Date Reported: Apr 24, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040688-2/10
Project #/Name: None / Newhall
Sample ID: PR 15 2-1

	Your Values (lbs/acre 6" deep)	Suggested Values
Ammonia (NH_3-N)	3.8	10-50 Low
Nitrate (NO_3-N)	11	20-100 Low
Total Available N	15	75-150 Low
Phosphorous(P_2O_5)	130	100-300 OK
Potassium (K_2O)	260	450-750 Low
Calcium (Ca)	2900	2299-2874 High
Magnesium (Mg)	480	300-600 OK
Sulfate (SO_4-S)	3.3	100-200 Low
Sodium (Na)	11	< 250 See SAR
Chloride (Cl)	2.8	1-100 OK
ECe (dS/m)	0.17	0.2-4 Low
Copper (Cu)	0.89	1 + Low
Zinc (Zn)	1.0	3 + Low
Iron (Fe)	46	8 + OK
Manganese (Mn)	11	4 + OK
Boron (B)	0.38	1-4 Low
SAR	0.12	0-6 OK
CEC (meq/100gms)	9.6	10-20 OK
ESP (%)	0.26	0-10 OK
pHs Value	6.2	6.5-7.5 Low
Organic Matter (%)	1.3	

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
150	Phosphorous (P_2O_5)
300	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
1000	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.3
pH 7.0 needs	0.8

Gypsum Requirement (needed for clay treatment)
1.3 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	5.4	mg/Kg	KCl
NH_3-N	1.9	mg/Kg	KCl
P	28	mg/Kg	Olsen
SP	30	%	Sat
pHs	6.2	unit	Sat
ECe	0.17	dS/m	Sat
Ca	2.7	meq/L	Sat
Mg	1.3	meq/L	Sat
Na	0.17	meq/L	Sat
K	0.26	meq/L	Sat
Cl	0.13	meq/L	Sat
SO_4-S	0.17	meq/L	Sat
SAR	0.12	ratio	Calc
B	0.19	mg/Kg	CaCl2
Cu	0.45	mg/Kg	DTPA
Zn	0.51	mg/Kg	DTPA
Fe	23	mg/Kg	DTPA
Mn	5.5	mg/Kg	DTPA

Data:			Method
OrgMat	1.3	%	WalkBk
Org-C	0.77	%	WalkBk
SMP Bufffer pH	7.17	unit	SMP
GypReq	1.5	meq/100g	GypSol
Ca	1500	mg/Kg	NH_4OAc
Mg	240	mg/Kg	NH_4OAc
Na	5.6	mg/Kg	NH_4OAc
K	110	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages			
CEC	9.6	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	75.7	% of CEC	Calc.
Mg	21.0	% of CEC	Calc.
Na	0.3	% of CEC	Calc.
K	2.9	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

42 HANGAR WAY WATSONVILLE CALIFORNIA 95076 USA

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Work Order #: 7040688
Account #: 9690
Date Received: Apr 21, 2017
Date Reported: Apr 24, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040688-3/10
Project #/Name: None / Newhall
Sample ID: PR 15 4-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	3.2	10-50	Low
Nitrate (NO_3-N)	15	20-100	Low
Total Available N	18	75-150	Low
Phosphorous(P_2O_5)	100	100-300	OK
Potassium (K_2O)	150	450-750	Low
Calcium (Ca)	1000	2000-2500	Low
Magnesium (Mg)	190	300-600	Low
Sulfate (SO_4-S)	2.9	100-200	Low
Sodium (Na)	4.5	< 250	See SAR
Chloride (Cl)	4.0	1-100	OK
ECe (dS/m)	0.13	0.2-4	Low
Copper (Cu)	0.44	1 +	Low
Zinc (Zn)	1.3	3 +	Low
Iron (Fe)	110	8 +	OK
Manganese (Mn)	9.4	4 +	OK
Boron (B)	2.3	1-4	OK
SAR	0.16	0-6	OK
CEC (meq/100gms)	3.6	10-20	OK
ESP (%)	0.27	0-10	OK
pHs Value	5.9	6.5-7.5	Low
Organic Matter (%)	1.1		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
150	Phosphorous (P_2O_5)
400	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
1000	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.1
pH 6.5 needs	0.6
pH 7.0 needs	1.1

Gypsum Requirement (needed for clay treatment)
0.6 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	7.6	mg/Kg	KCl
NH_3-N	1.6	mg/Kg	KCl
P	23	mg/Kg	Olsen
SP	29	%	Sat
pHs	5.9	unit	Sat
ECe	0.13	dS/m	Sat
Ca	1.6	meq/L	Sat
Mg	0.81	meq/L	Sat
Na	0.17	meq/L	Sat
K	0.29	meq/L	Sat
Cl	0.19	meq/L	Sat
SO_4-S	0.15	meq/L	Sat
SAR	0.16	ratio	Calc
B	1.2	mg/Kg	CaCl2
Cu	0.22	mg/Kg	DTPA
Zn	0.63	mg/Kg	DTPA
Fe	57	mg/Kg	DTPA
Mn	4.7	mg/Kg	DTPA

Data:			Method
OrgMat	1.1	%	WalkBk
Org-C	0.65	%	WalkBk
SMP Bufffer pH	7.27	unit	SMP
GypReq	0.76	meq/100g	GypSol
Ca	520	mg/Kg	NH_4OAc
Mg	96	mg/Kg	NH_4OAc
Na	2.2	mg/Kg	NH_4OAc
K	63	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	3.6	meq/100gm	Calc.
NH_3-N	0.3	% of CEC	Calc.
Ca	72.6	% of CEC	Calc.
Mg	22.3	% of CEC	Calc.
Na	0.3	% of CEC	Calc.
K	4.5	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

42 HANGAR WAY
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Date Reported: Apr 24, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040688-4/10
Project #/Name: None / Newhall
Sample ID: PR 15 4-2

	Your Values (lbs/acre 6" deep)	Suggested Values
Ammonia (NH_3-N)	3.7	10-50 Low
Nitrate (NO_3-N)	51	20-100 OK
Total Available N	55	75-150 Low
Phosphorous(P_2O_5)	76	100-300 Low
Potassium (K_2O)	170	450-750 Low
Calcium (Ca)	2400	2000-2500 OK
Magnesium (Mg)	410	300-600 OK
Sulfate (SO_4-S)	2.9	100-200 Low
Sodium (Na)	26	< 250 See SAR
Chloride (Cl)	2.7	1-100 OK
ECe (dS/m)	0.15	0.2-4 Low
Copper (Cu)	0.59	1 + Low
Zinc (Zn)	0.97	3 + Low
Iron (Fe)	50	8 + OK
Manganese (Mn)	8.5	4 + OK
Boron (B)	0.93	1-4 Low
SAR	0.21	0-6 OK
CEC (meq/100gms)	8.0	10-20 OK
ESP (%)	0.71	0-10 OK
pHs Value	5.8	6.5-7.5 Low
Organic Matter (%)	1.3	

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

75	Nitrogen (N)
200	Phosphorous (P_2O_5)
400	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
2000	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep
needed to raise pH of soil to:

pH 6.0 needs	0.2
pH 6.5 needs	0.7
pH 7.0 needs	1.2

Gypsum Requirement (needed for clay treatment)
1.2 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	25	mg/Kg	KCl
NH_3-N	1.8	mg/Kg	KCl
P	17	mg/Kg	Olsen
SP	26	%	Sat
pHs	5.8	unit	Sat
ECe	0.15	dS/m	Sat
Ca	7.2	meq/L	Sat
Mg	2.3	meq/L	Sat
Na	0.46	meq/L	Sat
K	0.32	meq/L	Sat
Cl	0.14	meq/L	Sat
SO_4-S	0.17	meq/L	Sat
SAR	0.21	ratio	Calc
B	0.47	mg/Kg	CaCl2
Cu	0.29	mg/Kg	DTPA
Zn	0.49	mg/Kg	DTPA
Fe	25	mg/Kg	DTPA
Mn	4.3	mg/Kg	DTPA

Data:			Method
OrgMat	1.3	%	WalkBk
Org-C	0.76	%	WalkBk
SMP Bufffer pH	7.20	unit	SMP
GypReq	1.4	meq/100g	GypSol
Ca	1200	mg/Kg	NH_4OAc
Mg	210	mg/Kg	NH_4OAc
Na	13	mg/Kg	NH_4OAc
K	70	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	8.0	meq/100gm	Calc.
NH_3-N	0.2	% of CEC	Calc.
Ca	75.5	% of CEC	Calc.
Mg	21.4	% of CEC	Calc.
Na	0.7	% of CEC	Calc.
K	2.2	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst:

Mike Galloway

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SOIL CONTROL LAB

42 HANGAR WAY WATSONVILLE CALIFORNIA 95076 USA

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Work Order #: 7040688
Account #: 9690
Date Received: Apr 21, 2017
Date Reported: Apr 24, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040688-5/10
Project #/Name: None / Newhall
Sample ID: PR 16 3-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	3.7	10-50	Low
Nitrate (NO_3-N)	6.5	20-100	Low
Total Available N	10	75-150	Low
Phosphorous(P_2O_5)	80	100-300	Low
Potassium (K_2O)	200	510-851	Low
Calcium (Ca)	5600	4351-5439	High
Magnesium (Mg)	960	435-870	High
Sulfate (SO_4-S)	3.8	100-200	Low
Sodium (Na)	17	< 250	See SAR
Chloride (Cl)	2.6	1-100	OK
ECe (dS/m)	0.28	0.2-4	OK
Copper (Cu)	1.2	1 +	OK
Zinc (Zn)	1.0	3 +	Low
Iron (Fe)	24	8 +	OK
Manganese (Mn)	6.4	4 +	OK
Boron (B)	0.78	1-4	Low
SAR	0.13	0-6	OK
CEC (meq/100gms)	18	10-20	OK
ESP (%)	0.20	0-10	OK
pHs Value	7.2	6.5-7.5	OK
Organic Matter (%)	1.2		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
200	Phosphorous (P_2O_5)
450	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.0

Gypsum Requirement (needed for clay treatment)
1.8 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	3.3	mg/Kg	KCl
NH_3-N	1.8	mg/Kg	KCl
P	18	mg/Kg	Olsen
SP	34	%	Sat
pHs	7.2	unit	Sat
ECe	0.28	dS/m	Sat
Ca	3.2	meq/L	Sat
Mg	2.0	meq/L	Sat
Na	0.21	meq/L	Sat
K	0.12	meq/L	Sat
Cl	0.11	meq/L	Sat
SO_4-S	0.17	meq/L	Sat
SAR	0.13	ratio	Calc
B	0.39	mg/Kg	CaCl2
Cu	0.62	mg/Kg	DTPA
Zn	0.51	mg/Kg	DTPA
Fe	12	mg/Kg	DTPA
Mn	3.2	mg/Kg	DTPA

Data:			Method
OrgMat	1.2	%	WalkBk
Org-C	0.71	%	WalkBk
SMP Bufffer pH	7.18	unit	SMP
GypReq	2.1	meq/100g	GypSol
Ca	2800	mg/Kg	NH_4OAc
Mg	480	mg/Kg	NH_4OAc
Na	8.5	mg/Kg	NH_4OAc
K	82	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	18	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	76.6	% of CEC	Calc.
Mg	22.0	% of CEC	Calc.
Na	0.2	% of CEC	Calc.
K	1.2	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

42 HANGAR WAY WATSONVILLE CALIFORNIA 95076 USA

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Work Order #: 7040688
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Date Received: Apr 21, 2017
Date Reported: Apr 24, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040688-6/10
Project #/Name: None / Newhall
Sample ID: PR 16 8-1

	Your Values (lbs/acre 6" deep)	Suggested Values	RECOMMENDATIONS ALL VALUES lbs/acre 6" deep
Ammonia (NH_3-N)	2.8	10-50 Low	125 Nitrogen (N)
Nitrate (NO_3-N)	9.1	20-100 Low	200 Phosphorous (P_2O_5)
Total Available N	12	75-150 Low	500 Potassium (K_2O)
Phosphorous(P_2O_5)	82	100-300 Low	0 Gypsum ($CaSO_4$)
Potassium (K_2O)	98	450-750 Low	0 Lime ($CaCO_3$)
Calcium (Ca)	4700	3721-4651 High	0 Dolomite ($CaCO_3$ & $MgCO_3$)
Magnesium (Mg)	860	372-744 High	0 Sulfur
Sulfate (SO_4-S)	3.7	100-200 Low	*Gypsum adds Ca and doesn't affect pH; Lime adds Ca
Sodium (Na)	22	< 250 See SAR	and raises pH; Dolomite adds Ca & Mg & raises pH.
Chloride (Cl)	3.0	1-100 OK	
ECe (dS/m)	0.17	0.2-4 Low	Lime Requirement:
Copper (Cu)	0.54	1 + Low	Tons of 100% $CaCO_3$ Lime per Acre 6" deep
Zinc (Zn)	0.71	3 + Low	needed to raise pH of soil to:
Iron (Fe)	35	8 + OK	
Manganese (Mn)	8.2	4 + OK	pH 6.0 needs 0.0
Boron (B)	0.46	1-4 Low	pH 6.5 needs 0.0
SAR	0.16	0-6 OK	pH 7.0 needs 0.3
CEC (meq/100gms)	16	10-20 OK	
ESP (%)	0.31	0-10 OK	Gypsum Requirement (needed for clay treatment)
pHs Value	6.7	6.5-7.5 OK	1.9 tons per acre 6" deep
Organic Matter (%)	1.2		Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	4.5	mg/Kg	KCl
NH_3-N	1.4	mg/Kg	KCl
P	19	mg/Kg	Olsen
SP	33	%	Sat
pHs	6.7	unit	Sat
ECe	0.17	dS/m	Sat
Ca	3.9	meq/L	Sat
Mg	1.7	meq/L	Sat
Na	0.28	meq/L	Sat
K	0.10	meq/L	Sat
Cl	0.13	meq/L	Sat
SO_4-S	0.17	meq/L	Sat
SAR	0.16	ratio	Calc
B	0.23	mg/Kg	CaCl2
Cu	0.27	mg/Kg	DTPA
Zn	0.36	mg/Kg	DTPA
Fe	17	mg/Kg	DTPA
Mn	4.1	mg/Kg	DTPA

Data:			Method
OrgMat	1.2	%	WalkBk
Org-C	0.68	%	WalkBk
SMP Bufffer pH	7.13	unit	SMP
GypReq	2.3	meq/100g	GypSol
Ca	2400	mg/Kg	NH_4OAc
Mg	430	mg/Kg	NH_4OAc
Na	11	mg/Kg	NH_4OAc
K	41	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	16	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	75.8	% of CEC	Calc.
Mg	23.1	% of CEC	Calc.
Na	0.3	% of CEC	Calc.
K	0.7	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

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Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040688-7/10
Project #/Name: None / Newhall
Sample ID: PR 20 7-1

	Your Values (lbs/acre 6" deep)	Suggested Values
Ammonia (NH_3-N)	3.4	10-50 Low
Nitrate (NO_3-N)	< 4	20-100 Low
Total Available N	5.2	75-150 Low
Phosphorous(P_2O_5)	130	100-300 OK
Potassium (K_2O)	140	535-892 Low
Calcium (Ca)	5900	4564-5705 High
Magnesium (Mg)	990	456-912 High
Sulfate (SO_4-S)	2.8	100-200 Low
Sodium (Na)	16	< 250 See SAR
Chloride (Cl)	3.0	1-100 OK
ECe (dS/m)	0.19	0.2-4 Low
Copper (Cu)	0.60	1 + Low
Zinc (Zn)	0.88	3 + Low
Iron (Fe)	41	8 + OK
Manganese (Mn)	11	4 + OK
Boron (B)	0.47	1-4 Low
SAR	0.16	0-6 OK
CEC (meq/100gms)	19	10-20 OK
ESP (%)	0.18	0-10 OK
pHs Value	6.9	6.5-7.5 OK
Organic Matter (%)	0.96	

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
150	Phosphorous (P_2O_5)
550	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.1

Gypsum Requirement (needed for clay treatment)
2.1 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	< 2	mg/Kg	KCl
NH_3-N	1.7	mg/Kg	KCl
P	30	mg/Kg	Olsen
SP	31	%	Sat
pHs	6.9	unit	Sat
ECe	0.19	dS/m	Sat
Ca	2.3	meq/L	Sat
Mg	1.2	meq/L	Sat
Na	0.21	meq/L	Sat
K	0.097	meq/L	Sat
Cl	0.14	meq/L	Sat
SO_4-S	0.14	meq/L	Sat
SAR	0.16	ratio	Calc
B	0.24	mg/Kg	CaCl2
Cu	0.30	mg/Kg	DTPA
Zn	0.44	mg/Kg	DTPA
Fe	21	mg/Kg	DTPA
Mn	5.3	mg/Kg	DTPA

Data:			Method
OrgMat	0.96	%	WalkBk
Org-C	0.56	%	WalkBk
SMP Bufffer pH	7.10	unit	SMP
GypReq	2.5	meq/100g	GypSol
Ca	2900	mg/Kg	NH_4OAc
Mg	490	mg/Kg	NH_4OAc
Na	7.8	mg/Kg	NH_4OAc
K	57	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	19	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	77.4	% of CEC	Calc.
Mg	21.6	% of CEC	Calc.
Na	0.2	% of CEC	Calc.
K	0.8	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

42 HANGAR WAY WATSONVILLE CALIFORNIA 95076 USA

TEL: 831-724-5422
FAX: 831-724-3188

Work Order #: 7040688
Account #: 9690
Date Received: Apr 21, 2017
Date Reported: Apr 24, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040688-8/10
Project #/Name: None / Newhall
Sample ID: PR 20 11-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	3.8	10-50	Low
Nitrate (NO_3-N)	6.3	20-100	Low
Total Available N	10	75-150	Low
Phosphorous(P_2O_5)	78	100-300	Low
Potassium (K_2O)	210	450-750	Low
Calcium (Ca)	3100	2660-3325	OK
Magnesium (Mg)	720	300-600	High
Sulfate (SO_4-S)	4.4	100-200	Low
Sodium (Na)	26	< 250	See SAR
Chloride (Cl)	3.0	1-100	OK
ECe (dS/m)	0.19	0.2-4	Low
Copper (Cu)	0.54	1 +	Low
Zinc (Zn)	0.92	3 +	Low
Iron (Fe)	51	8 +	OK
Manganese (Mn)	8.8	4 +	OK
Boron (B)	0.57	1-4	Low
SAR	0.23	0-6	OK
CEC (meq/100gms)	11	10-20	OK
ESP (%)	0.52	0-10	OK
pHs Value	6.4	6.5-7.5	Low
Organic Matter (%)	1.4		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
200	Phosphorous (P_2O_5)
350	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.1
pH 7.0 needs	0.6

Gypsum Requirement (needed for clay treatment)
2.1 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	3.2	mg/Kg	KCl
NH_3-N	1.9	mg/Kg	KCl
P	18	mg/Kg	Olsen
SP	34	%	Sat
pHs	6.4	unit	Sat
ECe	0.19	dS/m	Sat
Ca	4.7	meq/L	Sat
Mg	2.3	meq/L	Sat
Na	0.43	meq/L	Sat
K	0.22	meq/L	Sat
Cl	0.13	meq/L	Sat
SO_4-S	0.20	meq/L	Sat
SAR	0.23	ratio	Calc
B	0.28	mg/Kg	CaCl2
Cu	0.27	mg/Kg	DTPA
Zn	0.46	mg/Kg	DTPA
Fe	25	mg/Kg	DTPA
Mn	4.4	mg/Kg	DTPA

Data:			Method
OrgMat	1.4	%	WalkBk
Org-C	0.79	%	WalkBk
SMP Bufffer pH	7.17	unit	SMP
GypReq	2.4	meq/100g	GypSol
Ca	1600	mg/Kg	NH_4OAc
Mg	360	mg/Kg	NH_4OAc
Na	13	mg/Kg	NH_4OAc
K	86	mg/Kg	NH_4OAc
Moisture	NA	%	Oven dry

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	11	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	70.2	% of CEC	Calc.
Mg	27.2	% of CEC	Calc.
Na	0.5	% of CEC	Calc.
K	2.0	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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42 HANGAR WAY WATSONVILLE CALIFORNIA 95076 USA

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FAX: 831-724-3188

Work Order #: 7040688
Account #: 9690
Date Received: Apr 21, 2017
Date Reported: Apr 24, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040688-9/10
Project #/Name: None / Newhall
Sample ID: PR 20 16-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	3.0	10-50	Low
Nitrate (NO_3-N)	15	20-100	Low
Total Available N	18	75-150	Low
Phosphorous(P_2O_5)	140	100-300	OK
Potassium (K_2O)	110	450-750	Low
Calcium (Ca)	3300	2711-3389	OK
Magnesium (Mg)	670	300-600	High
Sulfate (SO_4-S)	4.1	100-200	Low
Sodium (Na)	13	< 250	See SAR
Chloride (Cl)	2.8	1-100	OK
ECe (dS/m)	0.14	0.2-4	Low
Copper (Cu)	5.3	1 +	OK
Zinc (Zn)	1.6	3 +	Low
Iron (Fe)	47	8 +	OK
Manganese (Mn)	14	4 +	OK
Boron (B)	0.36	1-4	Low
SAR	0.14	0-6	OK
CEC (meq/100gms)	11	10-20	OK
ESP (%)	0.26	0-10	OK
pHs Value	6.6	6.5-7.5	OK
Organic Matter (%)	1.0		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
150	Phosphorous (P_2O_5)
450	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.4

Gypsum Requirement (needed for clay treatment)
1.9 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	7.3	mg/Kg	KCl
NH_3-N	1.5	mg/Kg	KCl
P	31	mg/Kg	Olsen
SP	29	%	Sat
pHs	6.6	unit	Sat
ECe	0.14	dS/m	Sat
Ca	2.1	meq/L	Sat
Mg	1.1	meq/L	Sat
Na	0.18	meq/L	Sat
K	0.095	meq/L	Sat
Cl	0.14	meq/L	Sat
SO_4-S	0.22	meq/L	Sat
SAR	0.14	ratio	Calc
B	0.18	mg/Kg	CaCl2
Cu	2.6	mg/Kg	DTPA
Zn	0.82	mg/Kg	DTPA
Fe	23	mg/Kg	DTPA
Mn	7.2	mg/Kg	DTPA

Data:			Method
OrgMat	1.0	%	WalkBk
Org-C	0.60	%	WalkBk
SMP Bufffer pH	7.20	unit	SMP
GypReq	2.2	meq/100g	GypSol
Ca	1700	mg/Kg	NH_4OAc
Mg	330	mg/Kg	NH_4OAc
Na	6.7	mg/Kg	NH_4OAc
K	47	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	11	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	74.0	% of CEC	Calc.
Mg	24.6	% of CEC	Calc.
Na	0.3	% of CEC	Calc.
K	1.1	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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Work Order #: 7040688
Account #: 9690
Date Received: Apr 21, 2017
Date Reported: Apr 24, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040688-10/10
Project #/Name: None / Newhall
Sample ID: PR 20 19-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	3.0	10-50	Low
Nitrate (NO_3-N)	< 4	20-100	Low
Total Available N	5.3	75-150	Low
Phosphorous(P_2O_5)	96	100-300	Low
Potassium (K_2O)	210	450-750	Low
Calcium (Ca)	3400	2888-3610	OK
Magnesium (Mg)	820	300-600	High
Sulfate (SO_4-S)	2.7	100-200	Low
Sodium (Na)	11	< 250	See SAR
Chloride (Cl)	3.9	1-100	OK
ECe (dS/m)	0.12	0.2-4	Low
Copper (Cu)	0.97	1 +	Low
Zinc (Zn)	0.78	3 +	Low
Iron (Fe)	43	8 +	OK
Manganese (Mn)	7.8	4 +	OK
Boron (B)	0.30	1-4	Low
SAR	0.091	0-6	OK
CEC (meq/100gms)	12	10-20	OK
ESP (%)	0.21	0-10	OK
pHs Value	6.3	6.5-7.5	Low
Organic Matter (%)	0.91		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
200	Phosphorous (P_2O_5)
350	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
1000	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.2
pH 7.0 needs	0.7

Gypsum Requirement (needed for clay treatment)
1.7 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	< 2	mg/Kg	KCl
NH_3-N	1.5	mg/Kg	KCl
P	22	mg/Kg	Olsen
SP	28	%	Sat
pHs	6.3	unit	Sat
ECe	0.12	dS/m	Sat
Ca	4.0	meq/L	Sat
Mg	2.2	meq/L	Sat
Na	0.16	meq/L	Sat
K	0.22	meq/L	Sat
Cl	0.20	meq/L	Sat
SO_4-S	0.15	meq/L	Sat
SAR	0.091	ratio	Calc
B	0.15	mg/Kg	CaCl2
Cu	0.48	mg/Kg	DTPA
Zn	0.39	mg/Kg	DTPA
Fe	22	mg/Kg	DTPA
Mn	3.9	mg/Kg	DTPA

Data:			Method
OrgMat	0.91	%	WalkBk
Org-C	0.53	%	WalkBk
SMP Bufffer pH	7.22	unit	SMP
GypReq	2.0	meq/100g	GypSol
Ca	1700	mg/Kg	NH_4OAc
Mg	410	mg/Kg	NH_4OAc
Na	5.7	mg/Kg	NH_4OAc
K	86	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	12	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	69.7	% of CEC	Calc.
Mg	28.2	% of CEC	Calc.
Na	0.2	% of CEC	Calc.
K	1.8	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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WATSONVILLE
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TEL: 831-724-5422
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7040688-10-9690

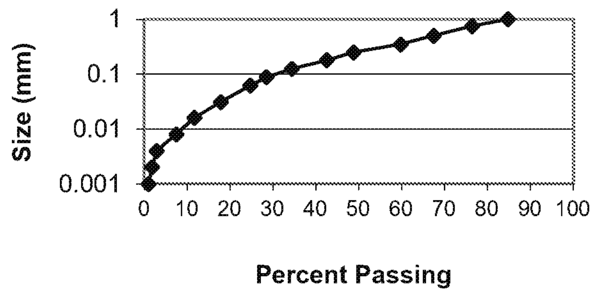
Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

April 28, 2017

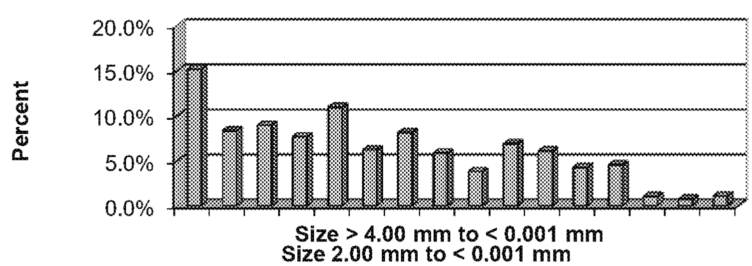
Particle Size Distribution

LABORATORY #: 7040688-1/10
IDENTIFICATION: PR 15 1-1
DATE RECEIVED: April 21, 2017

*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	15.2%	15.2%
1 to 0.75		8.3%	23.5%
0.75-0.50		9.0%	32.5%
0.50-0.35		7.7%	40.2%
0.35-0.25		11.0%	51.2%
0.25-0.18		6.2%	57.4%
0.18-0.125		8.1%	65.6%
0.125-0.088		5.9%	71.4%
0.088-0.062		3.8%	75.3%
0.062-0.031	Silt	6.9%	82.1%
0.031-0.016		6.1%	88.2%
0.016-0.008		4.3%	92.5%
0.008-0.004		4.6%	97.1%
0.004-0.002		1.1%	98.1%
0.002-0.001	Clay	0.8%	98.9%
< 0.001		1.1%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		12.8%	-



Very Coarse Sand %	15.2%		
Coarse Sand %	17.3%		
Medium Sand %	18.6%		
Fine Sand %	20.3%		
Very Fine Sand %	3.8%		
Classification:	**Loamy Sand**		
Sand	75.3%		
Silt	22.9%		
Clay	1.9%		
Effective Size (mm):	10%	=	0.0127
	60%	=	0.3542
Uniformity Coeff. (60%/10%)		=	27.93



Mike Galloway

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Dudek
605 3rd Street
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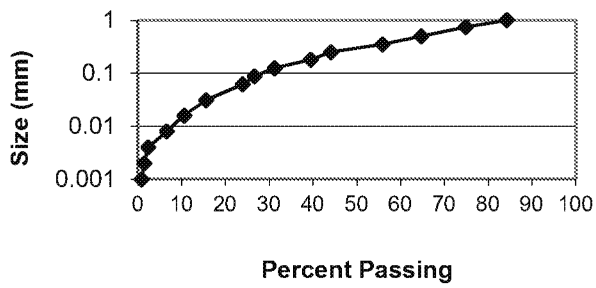
April 28, 2017

Particle Size Distribution

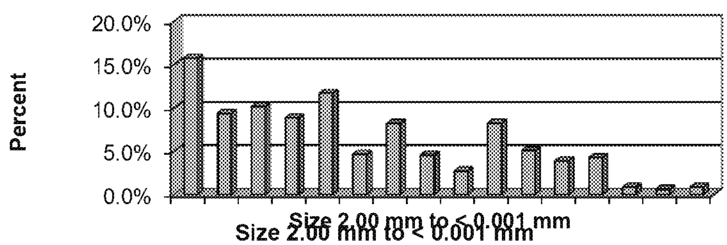
LABORATORY #: 7040688-2/10
IDENTIFICATION: PR 15 2-1
DATE RECEIVED: April 21, 2017



*Gravel and stones are removed first

SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	15.7%	15.7%
1 to 0.75		9.4%	25.1%
0.75-0.50		10.2%	35.3%
0.50-0.35		8.9%	44.2%
0.35-0.25		11.7%	55.9%
0.25-0.18		4.7%	60.5%
0.18-0.125		8.2%	68.8%
0.125-0.088		4.6%	73.3%
0.088-0.062		2.8%	76.1%
0.062-0.031	Silt	8.3%	84.3%
0.031-0.016		5.1%	89.4%
0.016-0.008		3.9%	93.4%
0.008-0.004		4.3%	97.6%
0.004-0.002		0.9%	98.5%
0.002-0.001	Clay	0.6%	99.1%
< 0.001		0.9%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		10.9%	-

Very Coarse Sand %	15.7%		
Coarse Sand %	19.6%		
Medium Sand %	20.6%		
Fine Sand %	17.5%		
Very Fine Sand %	2.8%		
Classification:	**Loamy Sand**		
Sand	76.1%		
Silt	22.4%		
Clay	1.5%		
Effective Size (mm):	10%	=	0.0148
	60%	=	0.4205
Uniformity Coeff. (60%/10%)		=	28.35



Mike Galloway

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7040688-10-9690

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

April 28, 2017

Particle Size Distribution

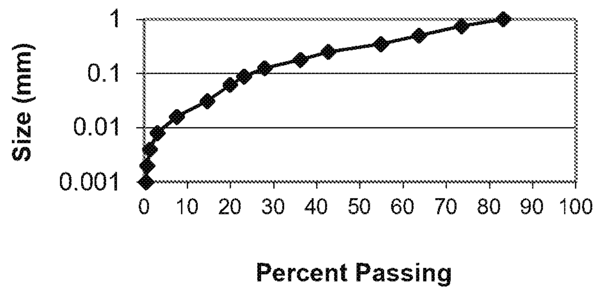
LABORATORY #: 7040688-3/10
IDENTIFICATION: PR 15 4-1
DATE RECEIVED: April 21, 2017

*Gravel and stones are removed first

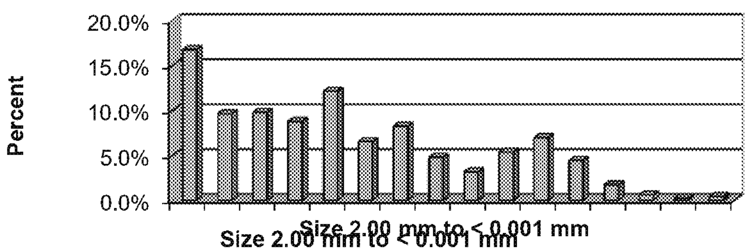
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	16.8%	16.8%
1 to 0.75		9.7%	26.5%
0.75-0.50		9.8%	36.3%
0.50-0.35		8.8%	45.1%
0.35-0.25		12.2%	57.3%
0.25-0.18		6.5%	63.8%
0.18-0.125		8.3%	72.1%
0.125-0.088		4.8%	76.9%
0.088-0.062		3.2%	80.0%
0.062-0.031	Silt	5.4%	85.4%
0.031-0.016		7.0%	92.4%
0.016-0.008		4.5%	96.9%
0.008-0.004		1.8%	98.7%
0.004-0.002		0.6%	99.3%
0.002-0.001	Clay	0.3%	99.5%
< 0.001		0.5%	100.0%

*Gravel % based on whole sample (nothing removed)

Gravel		10.2%	-



Very Coarse Sand %	16.8%		
Coarse Sand %	19.5%		
Medium Sand %	21.0%		
Fine Sand %	19.6%		
Very Fine Sand %	3.2%		
Classification:	**Loamy Sand**		
Sand	80.0%		
Silt	19.3%		
Clay	0.7%		
Effective Size (mm):	10%	=	0.0212
	60%	=	0.4366
Uniformity Coeff. (60%/10%)		=	20.61



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7040688-10-9690

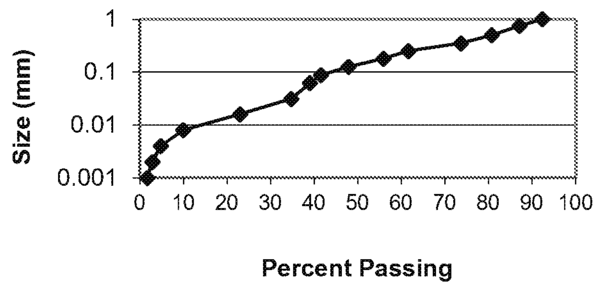
Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

April 28, 2017

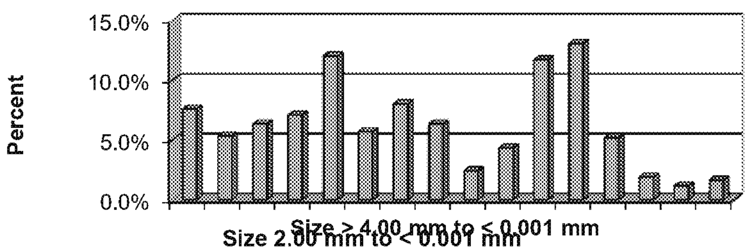
Particle Size Distribution

LABORATORY #: 7040688-4/10
IDENTIFICATION: PR 15 4-2
DATE RECEIVED: April 21, 2017

*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	7.6%	7.6%
1 to 0.75		5.3%	12.9%
0.75-0.50		6.4%	19.3%
0.50-0.35		7.1%	26.4%
0.35-0.25		12.0%	38.4%
0.25-0.18		5.7%	44.1%
0.18-0.125		8.0%	52.1%
0.125-0.088		6.3%	58.5%
0.088-0.062		2.5%	60.9%
0.062-0.031	Silt	4.3%	65.3%
0.031-0.016		11.7%	77.0%
0.016-0.008		13.1%	90.1%
0.008-0.004		5.2%	95.2%
0.004-0.002		1.9%	97.2%
0.002-0.001	Clay	1.2%	98.3%
< 0.001		1.7%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		4.6%	-



Very Coarse Sand %	7.6%		
Coarse Sand %	11.7%		
Medium Sand %	19.1%		
Fine Sand %	20.1%		
Very Fine Sand %	2.5%		
Classification:	**Sandy Loam**		
Sand	60.9%		
Silt	36.2%		
Clay	2.8%		
Effective Size (mm):	10%	=	0.0080
	60%	=	0.2304
Uniformity Coeff. (60%/10%)		=	28.66



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7040688-10-9690

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

April 28, 2017

Particle Size Distribution

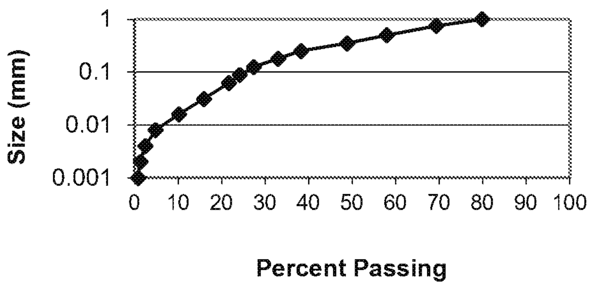
LABORATORY #: 7040688-5/10
IDENTIFICATION: PR 16 3-1
DATE RECEIVED: April 21, 2017

*Gravel and stones are removed first

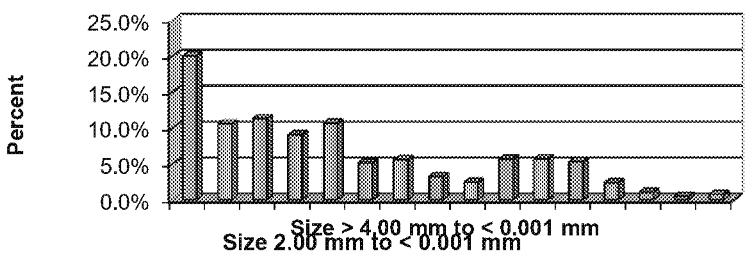
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	20.1%	20.1%
1 to 0.75		10.6%	30.7%
0.75-0.50		11.3%	42.0%
0.50-0.35		9.1%	51.1%
0.35-0.25		10.7%	61.8%
0.25-0.18		5.2%	67.0%
0.18-0.125		5.6%	72.6%
0.125-0.088		3.3%	75.9%
0.088-0.062		2.5%	78.4%
0.062-0.031	Silt	5.7%	84.1%
0.031-0.016		5.8%	89.8%
0.016-0.008		5.4%	95.2%
0.008-0.004		2.4%	97.6%
0.004-0.002		1.1%	98.7%
0.002-0.001	Clay	0.5%	99.2%
< 0.001		0.8%	100.0%

*Gravel % based on whole sample (nothing removed)

Gravel		24.0%	-



Very Coarse Sand %	20.1%		
Coarse Sand %	21.9%		
Medium Sand %	19.8%		
Fine Sand %	14.1%		
Very Fine Sand %	2.5%		
Classification:	**Loamy Sand**		
Sand	78.4%		
Silt	20.3%		
Clay	1.3%		
Effective Size (mm):	10%	=	0.0157
	60%	=	0.5445
Uniformity Coeff. (60%/10%)		=	34.59



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Dudek
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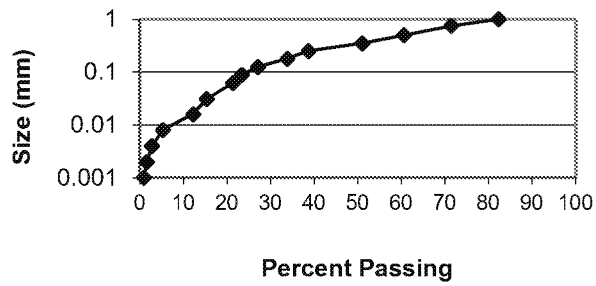
Attn: Andy Thomson

April 28, 2017

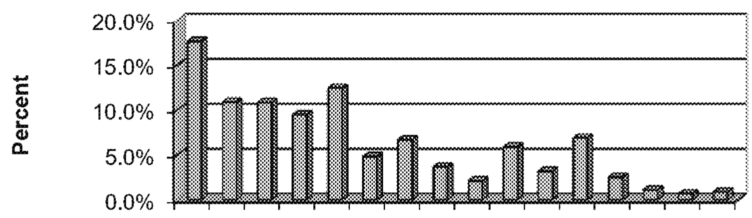
Particle Size Distribution

LABORATORY #: 7040688-6/10
IDENTIFICATION: PR 16 8-1
DATE RECEIVED: April 21, 2017

*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	17.7%	17.7%
1 to 0.75		10.9%	28.6%
0.75-0.50		10.8%	39.4%
0.50-0.35		9.5%	48.9%
0.35-0.25		12.5%	61.4%
0.25-0.18		4.8%	66.2%
0.18-0.125		6.7%	72.9%
0.125-0.088		3.7%	76.6%
0.088-0.062		2.1%	78.7%
0.062-0.031	Silt	5.9%	84.6%
0.031-0.016		3.2%	87.8%
0.016-0.008		6.9%	94.7%
0.008-0.004		2.5%	97.3%
0.004-0.002		1.1%	98.4%
0.002-0.001	Clay	0.7%	99.1%
< 0.001		0.9%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		7.3%	-



Very Coarse Sand %	17.7%		
Coarse Sand %	21.7%		
Medium Sand %	22.0%		
Fine Sand %	15.2%		
Very Fine Sand %	2.1%		
Classification:	**Loamy Sand**		
Sand	78.7%		
Silt	19.7%		
Clay	1.6%		
Effective Size (mm):	10%	=	0.0135
	60%	=	0.4905
Uniformity Coeff. (60%/10%)		=	36.40



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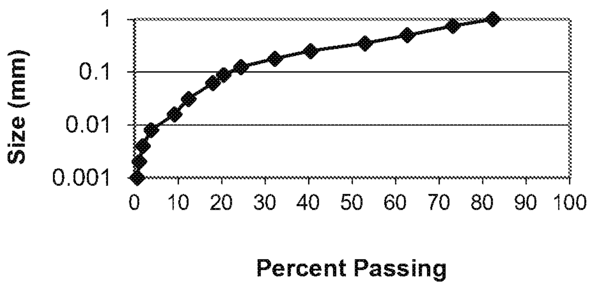
Attn: Andy Thomson

April 28, 2017

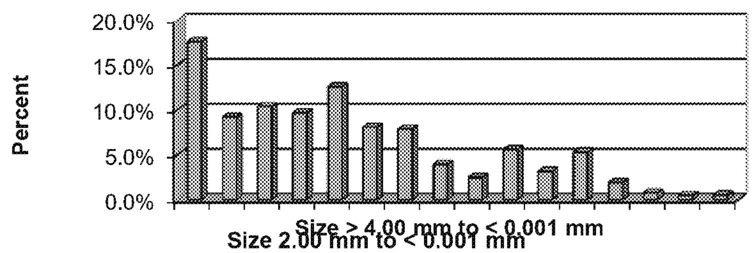
Particle Size Distribution

LABORATORY #: 7040688-7/10
IDENTIFICATION: PR 20 7-1
DATE RECEIVED: April 21, 2017

*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	17.6%	17.6%
1 to 0.75		9.2%	26.9%
0.75-0.50		10.4%	37.3%
0.50-0.35		9.7%	47.0%
0.35-0.25		12.6%	59.6%
0.25-0.18		8.1%	67.7%
0.18-0.125		7.9%	75.6%
0.125-0.088		4.0%	79.5%
0.088-0.062		2.5%	82.1%
0.062-0.031	Silt	5.6%	87.7%
0.031-0.016		3.2%	90.9%
0.016-0.008		5.3%	96.2%
0.008-0.004		1.9%	98.1%
0.004-0.002		0.8%	98.9%
0.002-0.001	Clay	0.5%	99.4%
< 0.001		0.6%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		26.5%	-



Very Coarse Sand %	17.6%		
Coarse Sand %	19.6%		
Medium Sand %	22.3%		
Fine Sand %	19.9%		
Very Fine Sand %	2.5%		
Classification:	**Loamy Sand**		
Sand	82.1%		
Silt	16.9%		
Clay	1.1%		
Effective Size (mm):	10%	=	0.0201
	60%	=	0.4580
Uniformity Coeff. (60%/10%)		=	22.78



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Attn: Andy Thomson

April 28, 2017

Particle Size Distribution

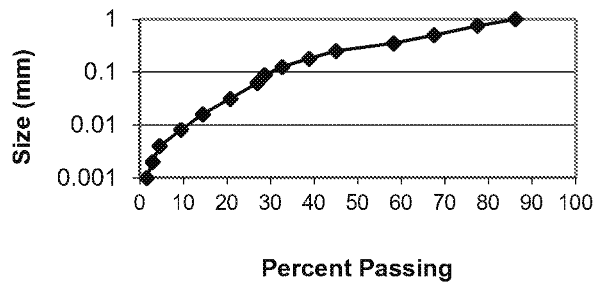
LABORATORY #: 7040688-8/10
IDENTIFICATION: PR 20 11-1
DATE RECEIVED: April 21, 2017

*Gravel and stones are removed first

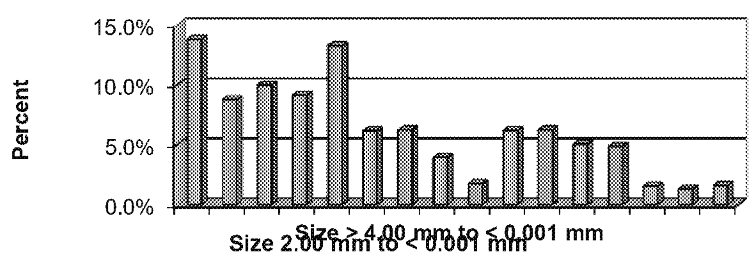
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	13.8%	13.8%
1 to 0.75		8.8%	22.6%
0.75-0.50		10.0%	32.6%
0.50-0.35		9.1%	41.7%
0.35-0.25		13.3%	54.9%
0.25-0.18		6.2%	61.1%
0.18-0.125		6.2%	67.4%
0.125-0.088		4.0%	71.3%
0.088-0.062		1.8%	73.1%
0.062-0.031	Silt	6.2%	79.3%
0.031-0.016		6.3%	85.5%
0.016-0.008		5.1%	90.6%
0.008-0.004		4.9%	95.5%
0.004-0.002		1.6%	97.1%
0.002-0.001	Clay	1.3%	98.4%
< 0.001		1.6%	100.0%

*Gravel % based on whole sample (nothing removed)

Gravel		11.8%	-



Very Coarse Sand %	13.8%		
Coarse Sand %	18.7%		
Medium Sand %	22.4%		
Fine Sand %	16.4%		
Very Fine Sand %	1.8%		
Classification:	**Loamy Sand**		
Sand	73.1%		
Silt	24.0%		
Clay	2.9%		
Effective Size (mm):	10%	=	0.0090
	60%	=	0.3777
Uniformity Coeff. (60%/10%)		=	42.04



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Dudek
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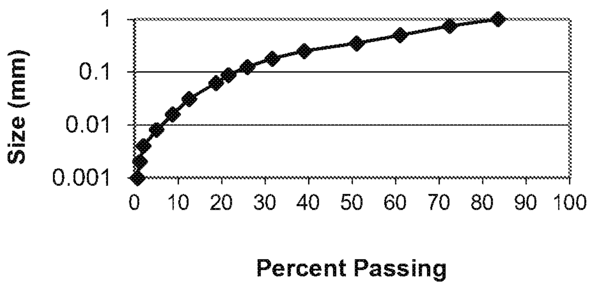
Attn: Andy Thomson

April 28, 2017

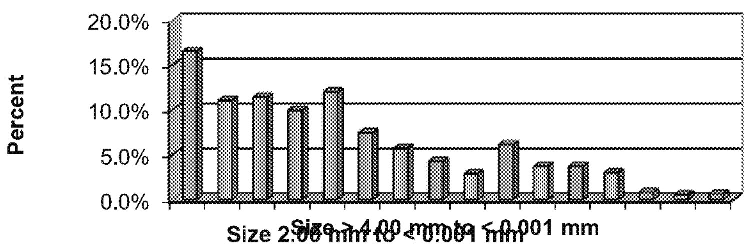
Particle Size Distribution

LABORATORY #: 7040688-9/10
IDENTIFICATION: PR 20 16-1
DATE RECEIVED: April 21, 2017

*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	16.5%	16.5%
1 to 0.75		11.0%	27.6%
0.75-0.50		11.4%	39.0%
0.50-0.35		10.0%	49.0%
0.35-0.25		12.0%	61.0%
0.25-0.18		7.5%	68.4%
0.18-0.125		5.7%	74.1%
0.125-0.088		4.3%	78.4%
0.088-0.062		2.9%	81.3%
0.062-0.031	Silt	6.1%	87.5%
0.031-0.016		3.7%	91.2%
0.016-0.008		3.7%	95.0%
0.008-0.004		3.0%	98.0%
0.004-0.002		0.8%	98.8%
0.002-0.001	Clay	0.5%	99.4%
< 0.001		0.6%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		16.6%	-



Very Coarse Sand %	16.5%		
Coarse Sand %	22.5%		
Medium Sand %	22.0%		
Fine Sand %	17.5%		
Very Fine Sand %	2.9%		
Classification:	**Loamy Sand**		
Sand	81.3%		
Silt	17.5%		
Clay	1.2%		
Effective Size (mm):	10%	=	0.0209
	60%	=	0.4850
Uniformity Coeff. (60%/10%)		=	23.17



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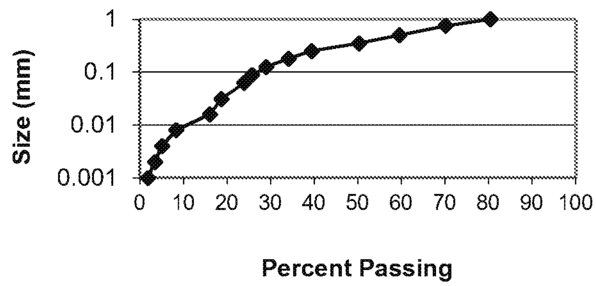
Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

April 28, 2017

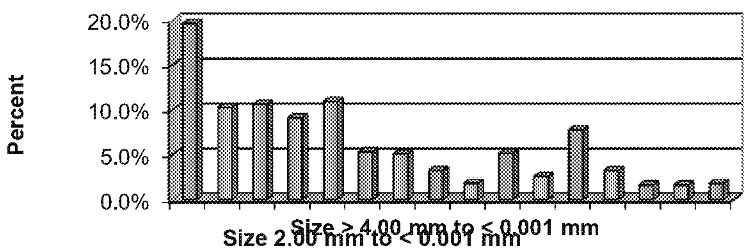
Particle Size Distribution

LABORATORY #: 7040688-10/10
IDENTIFICATION: PR 20 19-1
DATE RECEIVED: April 21, 2017

*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	19.6%	19.6%
1 to 0.75		10.3%	29.9%
0.75-0.50		10.6%	40.5%
0.50-0.35		9.1%	49.6%
0.35-0.25		10.9%	60.6%
0.25-0.18		5.3%	65.9%
0.18-0.125		5.1%	71.0%
0.125-0.088		3.3%	74.3%
0.088-0.062		1.8%	76.1%
0.062-0.031	Silt	5.2%	81.3%
0.031-0.016		2.6%	83.9%
0.016-0.008		7.8%	91.7%
0.008-0.004		3.3%	94.9%
0.004-0.002		1.6%	96.6%
0.002-0.001	Clay	1.6%	98.2%
< 0.001		1.8%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		36.1%	-



Very Coarse Sand %	19.6%		
Coarse Sand %	20.9%		
Medium Sand %	20.1%		
Fine Sand %	13.7%		
Very Fine Sand %	1.8%		
Classification:	**Loamy Sand**		
Sand	76.1%		
Silt	20.5%		
Clay	3.4%		
Effective Size (mm):	10%	=	0.0097
	60%	=	0.5119
Uniformity Coeff. (60%/10%)		=	52.64



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TEL: 831-724-5422
FAX: 831-724-3188

Work Order #: 7040309
Account #: 9690
Date Received: Apr 10, 2017
Date Reported: May 5, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040309-1/32
Project #/Name: None / None
Sample ID: VS1-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	10	10-50	OK
Nitrate (NO_3-N)	8.5	20-100	Low
Total Available N	19	75-150	Low
Phosphorous(P_2O_5)	240	100-300	OK
Potassium (K_2O)	790	562-937	OK
Calcium (Ca)	5400	4793-5991	OK
Magnesium (Mg)	1300	479-958	High
Sulfate (SO_4-S)	48	100-200	Low
Sodium (Na)	85	< 250	See SAR
Chloride (Cl)	23	1-100	OK
ECe (dS/m)	0.40	0.2-4	OK
Copper (Cu)	4.1	1 +	OK
Zinc (Zn)	2.9	3 +	Low
Iron (Fe)	99	8 +	OK
Manganese (Mn)	9.7	4 +	OK
Boron (B)	0.68	1-4	Low
SAR	0.38	0-6	OK
CEC (meq/100gms)	20	10-20	OK
ESP (%)	0.93	0-10	OK
pHs Value	6.1	6.5-7.5	Low
Organic Matter (%)	2.7		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
50	Phosphorous (P_2O_5)
0	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	2.3
pH 7.0 needs	2.7

Gypsum Requirement (needed for clay treatment)
2.6 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	4.3	mg/Kg	KCl
NH_3-N	5.2	mg/Kg	KCl
P	54	mg/Kg	Olsen
SP	70	%	Sat
pHs	6.1	unit	Sat
ECe	0.40	dS/m	Sat
Ca	3.7	meq/L	Sat
Mg	9.4	meq/L	Sat
Na	0.98	meq/L	Sat
K	2.1	meq/L	Sat
Cl	0.45	meq/L	Sat
SO_4-S	1.1	meq/L	Sat
SAR	0.38	ratio	Calc
B	0.34	mg/Kg	CaCl2
Cu	2.0	mg/Kg	DTPA
Zn	1.4	mg/Kg	DTPA
Fe	50	mg/Kg	DTPA
Mn	4.9	mg/Kg	DTPA

Data:			Method
OrgMat	2.7	%	WalkBk
Org-C	1.6	%	WalkBk
SMP Bufffer pH	6.67	unit	SMP
GypReq	3.1	meq/100g	GypSol
Ca	2700	mg/Kg	NH_4OAc
Mg	650	mg/Kg	NH_4OAc
Na	43	mg/Kg	NH_4OAc
K	330	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	20	meq/100gm	Calc.
NH_3-N	0.2	% of CEC	Calc.
Ca	67.6	% of CEC	Calc.
Mg	27.1	% of CEC	Calc.
Na	0.9	% of CEC	Calc.
K	4.2	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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Work Order #: 7040309
Account #: 9690
Date Received: Apr 10, 2017
Date Reported: May 5, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040309-2/32
Project #/Name: None / None
Sample ID: VS2-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	7.8	10-50	Low
Nitrate (NO_3-N)	5.3	20-100	Low
Total Available N	13	75-150	Low
Phosphorous(P_2O_5)	270	100-300	OK
Potassium (K_2O)	810	580-966	OK
Calcium (Ca)	5400	4942-6178	OK
Magnesium (Mg)	1400	494-988	High
Sulfate (SO_4-S)	32	100-200	Low
Sodium (Na)	100	< 250	See SAR
Chloride (Cl)	15	1-100	OK
ECe (dS/m)	0.25	0.2-4	OK
Copper (Cu)	5.6	1 +	OK
Zinc (Zn)	3.0	3 +	Low
Iron (Fe)	140	8 +	OK
Manganese (Mn)	5.1	4 +	OK
Boron (B)	0.49	1-4	Low
SAR	0.36	0-6	OK
CEC (meq/100gms)	21	10-20	OK
ESP (%)	1.1	0-10	OK
pHs Value	5.8	6.5-7.5	Low
Organic Matter (%)	2.2		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
0	Phosphorous (P_2O_5)
0	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	2.7
pH 6.5 needs	3.2
pH 7.0 needs	3.8

Gypsum Requirement (needed for clay treatment)
2.7 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	2.6	mg/Kg	KCl
NH_3-N	3.9	mg/Kg	KCl
P	61	mg/Kg	Olsen
SP	78	%	Sat
pHs	5.8	unit	Sat
ECe	0.25	dS/m	Sat
Ca	3.4	meq/L	Sat
Mg	3.9	meq/L	Sat
Na	0.69	meq/L	Sat
K	0.92	meq/L	Sat
Cl	0.27	meq/L	Sat
SO_4-S	0.64	meq/L	Sat
SAR	0.36	ratio	Calc
B	0.24	mg/Kg	CaCl2
Cu	2.8	mg/Kg	DTPA
Zn	1.5	mg/Kg	DTPA
Fe	68	mg/Kg	DTPA
Mn	2.6	mg/Kg	DTPA

Data:			Method
OrgMat	2.2	%	WalkBk
Org-C	1.3	%	WalkBk
SMP Bufffer pH	6.56	unit	SMP
GypReq	3.2	meq/100g	GypSol
Ca	2700	mg/Kg	NH_4OAc
Mg	700	mg/Kg	NH_4OAc
Na	52	mg/Kg	NH_4OAc
K	340	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	21	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	66.0	% of CEC	Calc.
Mg	28.5	% of CEC	Calc.
Na	1.1	% of CEC	Calc.
K	4.2	% of CEC	Calc.
H	0.1	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

42 HANGAR WAY WATSONVILLE CALIFORNIA 95076 USA

TEL: 831-724-5422
FAX: 831-724-3188

Work Order #: 7040309
Account #: 9690
Date Received: Apr 10, 2017
Date Reported: May 5, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040309-3/32
Project #/Name: None / None
Sample ID: VS3-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	6.8	10-50	Low
Nitrate (NO_3-N)	6.2	20-100	Low
Total Available N	13	75-150	Low
Phosphorous(P_2O_5)	94	100-300	Low
Potassium (K_2O)	580	884-1474	Low
Calcium (Ca)	11000	7538-9423	High
Magnesium (Mg)	570	753-1507	Low
Sulfate (SO_4-S)	30	100-200	Low
Sodium (Na)	110	< 250	See SAR
Chloride (Cl)	22	1-100	OK
ECe (dS/m)	0.45	0.2-4	OK
Copper (Cu)	4.8	1 +	OK
Zinc (Zn)	1.2	3 +	Low
Iron (Fe)	32	8 +	OK
Manganese (Mn)	1.9	4 +	Low
Boron (B)	1.2	1-4	OK
SAR	0.30	0-6	OK
CEC (meq/100gms)	31	10-20	OK
ESP (%)	0.76	0-10	OK
pHs Value	7.3	6.5-7.5	OK
Organic Matter (%)	2.6		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
200	Phosphorous (P_2O_5)
550	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.0

Gypsum Requirement (needed for clay treatment)
0.8 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	3.1	mg/Kg	KCl
NH_3-N	3.4	mg/Kg	KCl
P	21	mg/Kg	Olsen
SP	100	%	Sat
pHs	7.3	unit	Sat
ECe	0.45	dS/m	Sat
Ca	4.8	meq/L	Sat
Mg	0.89	meq/L	Sat
Na	0.50	meq/L	Sat
K	0.16	meq/L	Sat
Cl	0.32	meq/L	Sat
SO_4-S	0.47	meq/L	Sat
SAR	0.30	ratio	Calc
B	0.60	mg/Kg	CaCl2
Cu	2.4	mg/Kg	DTPA
Zn	0.62	mg/Kg	DTPA
Fe	16	mg/Kg	DTPA
Mn	0.94	mg/Kg	DTPA

Data:			Method
OrgMat	2.6	%	WalkBk
Org-C	1.5	%	WalkBk
SMP Bufffer pH	7.30	unit	SMP
GypReq	0.90	meq/100g	GypSol
Ca	5600	mg/Kg	NH_4OAc
Mg	280	mg/Kg	NH_4OAc
Na	55	mg/Kg	NH_4OAc
K	240	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	31	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	89.7	% of CEC	Calc.
Mg	7.5	% of CEC	Calc.
Na	0.8	% of CEC	Calc.
K	2.0	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

42 HANGAR WAY
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Work Order #: 7040309
Account #: 9690
Date Received: Apr 10, 2017
Date Reported: May 5, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040309-4/32
Project #/Name: None / None
Sample ID: VS3-2

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	7.5	10-50	Low
Nitrate (NO_3-N)	5.9	20-100	Low
Total Available N	13	75-150	Low
Phosphorous(P_2O_5)	82	100-300	Low
Potassium (K_2O)	390	680-1133	Low
Calcium (Ca)	7900	5795-7243	High
Magnesium (Mg)	870	579-1159	OK
Sulfate (SO_4-S)	26	100-200	Low
Sodium (Na)	150	< 250	See SAR
Chloride (Cl)	11	1-100	OK
ECe (dS/m)	0.33	0.2-4	OK
Copper (Cu)	3.3	1 +	OK
Zinc (Zn)	1.0	3 +	Low
Iron (Fe)	34	8 +	OK
Manganese (Mn)	3.0	4 +	Low
Boron (B)	0.39	1-4	Low
SAR	0.51	0-6	OK
CEC (meq/100gms)	24	10-20	OK
ESP (%)	1.4	0-10	OK
pHs Value	6.3	6.5-7.5	Low
Organic Matter (%)	2.5		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
200	Phosphorous (P_2O_5)
500	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep
needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.8
pH 7.0 needs	1.0

Gypsum Requirement (needed for clay treatment)
2.0 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	3.0	mg/Kg	KCl
NH_3-N	3.8	mg/Kg	KCl
P	19	mg/Kg	Olsen
SP	81	%	Sat
pHs	6.3	unit	Sat
ECe	0.33	dS/m	Sat
Ca	3.1	meq/L	Sat
Mg	1.7	meq/L	Sat
Na	0.79	meq/L	Sat
K	0.19	meq/L	Sat
Cl	0.19	meq/L	Sat
SO_4-S	0.50	meq/L	Sat
SAR	0.51	ratio	Calc
B	0.20	mg/Kg	CaCl2
Cu	1.6	mg/Kg	DTPA
Zn	0.51	mg/Kg	DTPA
Fe	17	mg/Kg	DTPA
Mn	1.5	mg/Kg	DTPA

Data:			Method
OrgMat	2.5	%	WalkBk
Org-C	1.5	%	WalkBk
SMP Bufffer pH	6.84	unit	SMP
GypReq	2.4	meq/100g	GypSol
Ca	4000	mg/Kg	NH_4OAc
Mg	430	mg/Kg	NH_4OAc
Na	75	mg/Kg	NH_4OAc
K	160	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	24	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	81.8	% of CEC	Calc.
Mg	15.0	% of CEC	Calc.
Na	1.4	% of CEC	Calc.
K	1.7	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

42 HANGAR WAY
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Work Order #: 7040309
Account #: 9690
Date Received: Apr 10, 2017
Date Reported: May 5, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040309-5/32
Project #/Name: None / None
Sample ID: VS4-1

	Your Values (lbs/acre 6" deep)	Suggested Values	RECOMMENDATIONS ALL VALUES lbs/acre 6" deep
Ammonia (NH_3-N)	5.4	10-50 Low	125 Nitrogen (N)
Nitrate (NO_3-N)	8.2	20-100 Low	150 Phosphorous (P_2O_5)
Total Available N	14	75-150 Low	200 Potassium (K_2O)
Phosphorous(P_2O_5)	100	100-300 OK	0 Gypsum ($CaSO_4$)
Potassium (K_2O)	680	613-1022 OK	0 Lime ($CaCO_3$)
Calcium (Ca)	7200	5227-6533 High	0 Dolomite ($CaCO_3$ & $MgCO_3$)
Magnesium (Mg)	690	522-1045 OK	0 Sulfur
Sulfate (SO_4-S)	22	100-200 Low	*Gypsum adds Ca and doesn't affect pH; Lime adds Ca
Sodium (Na)	110	< 250 See SAR	and raises pH; Dolomite adds Ca & Mg & raises pH.
Chloride (Cl)	13	1-100 OK	
ECe (dS/m)	0.43	0.2-4 OK	Lime Requirement:
Copper (Cu)	2.6	1 + OK	Tons of 100% $CaCO_3$ Lime per Acre 6" deep
Zinc (Zn)	1.8	3 + Low	needed to raise pH of soil to:
Iron (Fe)	29	8 + OK	
Manganese (Mn)	2.7	4 + Low	pH 6.0 needs 0.0
Boron (B)	1.3	1-4 OK	pH 6.5 needs 0.0
SAR	0.35	0-6 OK	pH 7.0 needs 0.1
CEC (meq/100gms)	22	10-20 OK	
ESP (%)	1.1	0-10 OK	Gypsum Requirement (needed for clay treatment)
pHs Value	6.9	6.5-7.5 OK	1.1 tons per acre 6" deep
Organic Matter (%)	2.2		Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	4.1	mg/Kg	KCl
NH_3-N	2.7	mg/Kg	KCl
P	24	mg/Kg	Olsen
SP	93	%	Sat
pHs	6.9	unit	Sat
ECe	0.43	dS/m	Sat
Ca	3.7	meq/L	Sat
Mg	0.87	meq/L	Sat
Na	0.53	meq/L	Sat
K	0.12	meq/L	Sat
Cl	0.20	meq/L	Sat
SO_4-S	0.36	meq/L	Sat
SAR	0.35	ratio	Calc
B	0.66	mg/Kg	CaCl2
Cu	1.3	mg/Kg	DTPA
Zn	0.88	mg/Kg	DTPA
Fe	15	mg/Kg	DTPA
Mn	1.4	mg/Kg	DTPA

Data:			Method
OrgMat	2.2	%	WalkBk
Org-C	1.3	%	WalkBk
SMP Bufffer pH	7.28	unit	SMP
GypReq	1.3	meq/100g	GypSol
Ca	3600	mg/Kg	NH_4OAc
Mg	340	mg/Kg	NH_4OAc
Na	54	mg/Kg	NH_4OAc
K	280	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	22	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	82.4	% of CEC	Calc.
Mg	13.1	% of CEC	Calc.
Na	1.1	% of CEC	Calc.
K	3.3	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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Work Order #: 7040309
Account #: 9690
Date Received: Apr 10, 2017
Date Reported: May 5, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040309-6/32
Project #/Name: None / None
Sample ID: VS5-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	4.7	10-50	Low
Nitrate (NO_3-N)	15	20-100	Low
Total Available N	20	75-150	Low
Phosphorous(P_2O_5)	180	100-300	OK
Potassium (K_2O)	1100	917-1528	OK
Calcium (Ca)	12000	7812-9765	High
Magnesium (Mg)	350	781-1562	Low
Sulfate (SO_4-S)	31	100-200	Low
Sodium (Na)	94	< 250	See SAR
Chloride (Cl)	13	1-100	OK
ECe (dS/m)	0.60	0.2-4	OK
Copper (Cu)	3.0	1 +	OK
Zinc (Zn)	3.2	3 +	OK
Iron (Fe)	25	8 +	OK
Manganese (Mn)	5.6	4 +	OK
Boron (B)	2.2	1-4	OK
SAR	0.37	0-6	OK
CEC (meq/100gms)	33	10-20	OK
ESP (%)	0.62	0-10	OK
pHs Value	7.5	6.5-7.5	OK
Organic Matter (%)	5.6		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
100	Phosphorous (P_2O_5)
200	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.0

Gypsum Requirement (needed for clay treatment)
0.6 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	7.5	mg/Kg	KCl
NH_3-N	2.4	mg/Kg	KCl
P	41	mg/Kg	Olsen
SP	86	%	Sat
pHs	7.5	unit	Sat
ECe	0.60	dS/m	Sat
Ca	6.2	meq/L	Sat
Mg	0.70	meq/L	Sat
Na	0.69	meq/L	Sat
K	0.40	meq/L	Sat
Cl	0.21	meq/L	Sat
SO_4-S	0.57	meq/L	Sat
SAR	0.37	ratio	Calc
B	1.1	mg/Kg	CaCl2
Cu	1.5	mg/Kg	DTPA
Zn	1.6	mg/Kg	DTPA
Fe	13	mg/Kg	DTPA
Mn	2.8	mg/Kg	DTPA

Data:			Method
OrgMat	5.6	%	WalkBk
Org-C	3.3	%	WalkBk
SMP Bufffer pH	7.38	unit	SMP
GypReq	0.70	meq/100g	GypSol
Ca	5900	mg/Kg	NH_4OAc
Mg	180	mg/Kg	NH_4OAc
Na	47	mg/Kg	NH_4OAc
K	450	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	33	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	91.2	% of CEC	Calc.
Mg	4.5	% of CEC	Calc.
Na	0.6	% of CEC	Calc.
K	3.5	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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Work Order #: 7040309
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Date Received: Apr 10, 2017
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Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040309-7/32
Project #/Name: None / None
Sample ID: VS6-1

	Your Values (lbs/acre 6" deep)	Suggested Values		RECOMMENDATIONS ALL VALUES lbs/acre 6" deep
Ammonia (NH_3-N)	5.0	10-50	Low	125 Nitrogen (N)
Nitrate (NO_3-N)	8.5	20-100	Low	150 Phosphorous (P_2O_5)
Total Available N	14	75-150	Low	600 Potassium (K_2O)
Phosphorous(P_2O_5)	100	100-300	OK	0 Gypsum ($CaSO_4$)
Potassium (K_2O)	470	853-1422	Low	0 Lime ($CaCO_3$)
Calcium (Ca)	11000	7268-9085	High	0 Dolomite ($CaCO_3$ & $MgCO_3$)
Magnesium (Mg)	300	726-1453	Low	0 Sulfur
Sulfate (SO_4-S)	27	100-200	Low	*Gypsum adds Ca and doesn't affect pH; Lime adds Ca
Sodium (Na)	150	< 250	See SAR	and raises pH; Dolomite adds Ca & Mg & raises pH.
Chloride (Cl)	12	1-100	OK	
ECe (dS/m)	0.54	0.2-4	OK	Lime Requirement:
Copper (Cu)	2.8	1 +	OK	Tons of 100% $CaCO_3$ Lime per Acre 6" deep
Zinc (Zn)	1.1	3 +	Low	needed to raise pH of soil to:
Iron (Fe)	21	8 +	OK	
Manganese (Mn)	1.8	4 +	Low	pH 6.0 needs 0.0
Boron (B)	1.6	1-4	OK	pH 6.5 needs 0.0
SAR	0.44	0-6	OK	pH 7.0 needs 0.0
CEC (meq/100gms)	30	10-20	OK	
ESP (%)	1.1	0-10	OK	Gypsum Requirement (needed for clay treatment)
pHs Value	7.3	6.5-7.5	OK	0.3 tons per acre 6" deep
Organic Matter (%)	4.4			Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	4.2	mg/Kg	KCl
NH_3-N	2.5	mg/Kg	KCl
P	23	mg/Kg	Olsen
SP	86	%	Sat
pHs	7.3	unit	Sat
ECe	0.54	dS/m	Sat
Ca	5.7	meq/L	Sat
Mg	0.58	meq/L	Sat
Na	0.78	meq/L	Sat
K	0.095	meq/L	Sat
Cl	0.20	meq/L	Sat
SO_4-S	0.50	meq/L	Sat
SAR	0.44	ratio	Calc
B	0.78	mg/Kg	CaCl2
Cu	1.4	mg/Kg	DTPA
Zn	0.55	mg/Kg	DTPA
Fe	10	mg/Kg	DTPA
Mn	0.90	mg/Kg	DTPA

Data:			Method
OrgMat	4.4	%	WalkBk
Org-C	2.6	%	WalkBk
SMP Bufffer pH	7.35	unit	SMP
GypReq	0.38	meq/100g	GypSol
Ca	5600	mg/Kg	NH_4OAc
Mg	150	mg/Kg	NH_4OAc
Na	74	mg/Kg	NH_4OAc
K	190	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	30	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	93.1	% of CEC	Calc.
Mg	4.2	% of CEC	Calc.
Na	1.1	% of CEC	Calc.
K	1.6	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

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Date Received: Apr 10, 2017
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Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040309-8/32
Project #/Name: None / None
Sample ID: VS6-2

	Your Values (lbs/acre 6" deep)	Suggested Values
Ammonia (NH_3-N)	10	10-50 OK
Nitrate (NO_3-N)	8.6	20-100 Low
Total Available N	19	75-150 Low
Phosphorous(P_2O_5)	180	100-300 OK
Potassium (K_2O)	410	710-1184 Low
Calcium (Ca)	8200	6055-7569 High
Magnesium (Mg)	940	605-1211 OK
Sulfate (SO_4-S)	29	100-200 Low
Sodium (Na)	110	< 250 See SAR
Chloride (Cl)	16	1-100 OK
ECe (dS/m)	0.49	0.2-4 OK
Copper (Cu)	3.4	1 + OK
Zinc (Zn)	2.6	3 + Low
Iron (Fe)	48	8 + OK
Manganese (Mn)	7.0	4 + OK
Boron (B)	0.55	1-4 Low
SAR	0.48	0-6 OK
CEC (meq/100gms)	25	10-20 OK
ESP (%)	0.97	0-10 OK
pHs Value	6.3	6.5-7.5 Low
Organic Matter (%)	5.1	

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
100	Phosphorous (P_2O_5)
500	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.8
pH 7.0 needs	1.0

Gypsum Requirement (needed for clay treatment)
1.5 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	4.3	mg/Kg	KCl
NH_3-N	5.2	mg/Kg	KCl
P	41	mg/Kg	Olsen
SP	84	%	Sat
pHs	6.3	unit	Sat
ECe	0.49	dS/m	Sat
Ca	3.7	meq/L	Sat
Mg	1.3	meq/L	Sat
Na	0.76	meq/L	Sat
K	0.097	meq/L	Sat
Cl	0.26	meq/L	Sat
SO_4-S	0.54	meq/L	Sat
SAR	0.48	ratio	Calc
B	0.27	mg/Kg	CaCl2
Cu	1.7	mg/Kg	DTPA
Zn	1.3	mg/Kg	DTPA
Fe	24	mg/Kg	DTPA
Mn	3.5	mg/Kg	DTPA

Data:			Method
OrgMat	5.1	%	WalkBk
Org-C	2.9	%	WalkBk
SMP Bufffer pH	6.84	unit	SMP
GypReq	1.8	meq/100g	GypSol
Ca	4100	mg/Kg	NH_4OAc
Mg	470	mg/Kg	NH_4OAc
Na	56	mg/Kg	NH_4OAc
K	170	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	25	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	81.6	% of CEC	Calc.
Mg	15.5	% of CEC	Calc.
Na	1.0	% of CEC	Calc.
K	1.7	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

ANALYTICAL CHEMISTS
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SOIL CONTROL LAB

42 HANGAR WAY
WATSONVILLE
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95076
USA

TEL: 831-724-5422
FAX: 831-724-3188

Work Order #: 7040309
Account #: 9690
Date Received: Apr 10, 2017
Date Reported: May 5, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040309-9/32
Project #/Name: None / None
Sample ID: VS6-3

	Your Values (lbs/acre 6" deep)	Suggested Values
Ammonia (NH_3-N)	8.7	10-50 Low
Nitrate (NO_3-N)	< 4	20-100 Low
Total Available N	11	75-150 Low
Phosphorous(P_2O_5)	230	100-300 OK
Potassium (K_2O)	1200	767-1278 OK
Calcium (Ca)	7600	6535-8168 OK
Magnesium (Mg)	1600	653-1307 High
Sulfate (SO_4-S)	20	100-200 Low
Sodium (Na)	99	< 250 See SAR
Chloride (Cl)	11	1-100 OK
ECe (dS/m)	0.26	0.2-4 OK
Copper (Cu)	3.9	1 + OK
Zinc (Zn)	2.1	3 + Low
Iron (Fe)	50	8 + OK
Manganese (Mn)	5.6	4 + OK
Boron (B)	0.59	1-4 Low
SAR	0.25	0-6 OK
CEC (meq/100gms)	27	10-20 OK
ESP (%)	0.79	0-10 OK
pHs Value	6.3	6.5-7.5 Low
Organic Matter (%)	4.3	

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
50	Phosphorous (P_2O_5)
0	Potassium (K_2O)
5000	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep
needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.5
pH 7.0 needs	0.6

Gypsum Requirement (needed for clay treatment)
2.5 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	< 2	mg/Kg	KCl
NH_3-N	4.4	mg/Kg	KCl
P	52	mg/Kg	Olsen
SP	86	%	Sat
pHs	6.3	unit	Sat
ECe	0.26	dS/m	Sat
Ca	2.5	meq/L	Sat
Mg	1.6	meq/L	Sat
Na	0.36	meq/L	Sat
K	0.33	meq/L	Sat
Cl	0.18	meq/L	Sat
SO_4-S	0.37	meq/L	Sat
SAR	0.25	ratio	Calc
B	0.30	mg/Kg	CaCl2
Cu	2.0	mg/Kg	DTPA
Zn	1.1	mg/Kg	DTPA
Fe	25	mg/Kg	DTPA
Mn	2.8	mg/Kg	DTPA

Data:			Method
OrgMat	4.3	%	WalkBk
Org-C	2.5	%	WalkBk
SMP Bufffer pH	6.87	unit	SMP
GypReq	3.0	meq/100g	GypSol
Ca	3800	mg/Kg	NH_4OAc
Mg	790	mg/Kg	NH_4OAc
Na	50	mg/Kg	NH_4OAc
K	510	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	27	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	70.0	% of CEC	Calc.
Mg	24.3	% of CEC	Calc.
Na	0.8	% of CEC	Calc.
K	4.8	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

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Work Order #: 7040309
Account #: 9690
Date Received: Apr 10, 2017
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Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040309-10/32
Project #/Name: None / None
Sample ID: VS6-4

	Your Values (lbs/acre 6" deep)	Suggested Values
Ammonia (NH_3-N)	5.9	10-50 Low
Nitrate (NO_3-N)	7.5	20-100 Low
Total Available N	13	75-150 Low
Phosphorous(P_2O_5)	210	100-300 OK
Potassium (K_2O)	880	809-1348 OK
Calcium (Ca)	9700	6893-8617 High
Magnesium (Mg)	820	689-1378 OK
Sulfate (SO_4-S)	17	100-200 Low
Sodium (Na)	88	< 250 See SAR
Chloride (Cl)	16	1-100 OK
ECe (dS/m)	0.46	0.2-4 OK
Copper (Cu)	3.1	1 + OK
Zinc (Zn)	5.2	3 + OK
Iron (Fe)	36	8 + OK
Manganese (Mn)	5.9	4 + OK
Boron (B)	1.4	1-4 OK
SAR	0.32	0-6 OK
CEC (meq/100gms)	29	10-20 OK
ESP (%)	0.66	0-10 OK
pHs Value	6.9	6.5-7.5 OK
Organic Matter (%)	7.1	

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
50	Phosphorous (P_2O_5)
200	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.1

Gypsum Requirement (needed for clay treatment)
1.4 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	3.8	mg/Kg	KCl
NH_3-N	3.0	mg/Kg	KCl
P	47	mg/Kg	Olsen
SP	91	%	Sat
pHs	6.9	unit	Sat
ECe	0.46	dS/m	Sat
Ca	4.2	meq/L	Sat
Mg	1.2	meq/L	Sat
Na	0.52	meq/L	Sat
K	0.20	meq/L	Sat
Cl	0.24	meq/L	Sat
SO_4-S	0.30	meq/L	Sat
SAR	0.32	ratio	Calc
B	0.70	mg/Kg	CaCl2
Cu	1.6	mg/Kg	DTPA
Zn	2.6	mg/Kg	DTPA
Fe	18	mg/Kg	DTPA
Mn	2.9	mg/Kg	DTPA

Data:			Method
OrgMat	7.1	%	WalkBk
Org-C	4.1	%	WalkBk
SMP Bufffer pH	7.18	unit	SMP
GypReq	1.7	meq/100g	GypSol
Ca	4800	mg/Kg	NH_4OAc
Mg	410	mg/Kg	NH_4OAc
Na	44	mg/Kg	NH_4OAc
K	360	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	29	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	84.1	% of CEC	Calc.
Mg	11.9	% of CEC	Calc.
Na	0.7	% of CEC	Calc.
K	3.2	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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42 HANGAR WAY
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Work Order #: 7040309
Account #: 9690
Date Received: Apr 10, 2017
Date Reported: May 5, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040309-11/32
Project #/Name: None / None
Sample ID: EL2-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	2.5	10-50	Low
Nitrate (NO_3-N)	6.7	20-100	Low
Total Available N	9.2	75-150	Low
Phosphorous(P_2O_5)	140	100-300	OK
Potassium (K_2O)	200	450-750	Low
Calcium (Ca)	1400	2000-2500	Low
Magnesium (Mg)	120	300-600	Low
Sulfate (SO_4-S)	5.8	100-200	Low
Sodium (Na)	6.5	< 250	See SAR
Chloride (Cl)	3.1	1-100	OK
ECe (dS/m)	0.18	0.2-4	Low
Copper (Cu)	0.32	1 +	Low
Zinc (Zn)	1.7	3 +	Low
Iron (Fe)	97	8 +	OK
Manganese (Mn)	5.8	4 +	OK
Boron (B)	< 0.1	1-4	Low
SAR	0.18	0-6	OK
CEC (meq/100gms)	4.2	10-20	OK
ESP (%)	0.34	0-10	OK
pHs Value	6.6	6.5-7.5	OK
Organic Matter (%)	0.82		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
150	Phosphorous (P_2O_5)
400	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep
needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.4

Gypsum Requirement (needed for clay treatment)
1.1 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	3.4	mg/Kg	KCl
NH_3-N	1.2	mg/Kg	KCl
P	33	mg/Kg	Olsen
SP	32	%	Sat
pHs	6.6	unit	Sat
ECe	0.18	dS/m	Sat
Ca	0.93	meq/L	Sat
Mg	0.30	meq/L	Sat
Na	0.14	meq/L	Sat
K	0.21	meq/L	Sat
Cl	0.14	meq/L	Sat
SO_4-S	0.28	meq/L	Sat
SAR	0.18	ratio	Calc
B	< 0.05	mg/Kg	CaCl2
Cu	0.16	mg/Kg	DTPA
Zn	0.85	mg/Kg	DTPA
Fe	48	mg/Kg	DTPA
Mn	2.9	mg/Kg	DTPA

Data:			Method
OrgMat	0.82	%	WalkBk
Org-C	0.48	%	WalkBk
SMP Bufffer pH	7.26	unit	SMP
GypReq	1.3	meq/100g	GypSol
Ca	700	mg/Kg	NH_4OAc
Mg	58	mg/Kg	NH_4OAc
Na	3.3	mg/Kg	NH_4OAc
K	83	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	4.2	meq/100gm	Calc.
NH_3-N	0.2	% of CEC	Calc.
Ca	83.0	% of CEC	Calc.
Mg	11.5	% of CEC	Calc.
Na	0.3	% of CEC	Calc.
K	5.0	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

42 HANGAR WAY
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Work Order #: 7040309
Account #: 9690
Date Received: Apr 10, 2017
Date Reported: May 5, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040309-12/32
Project #/Name: None / None
Sample ID: EL4-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	3.3	10-50	Low
Nitrate (NO_3-N)	5.9	20-100	Low
Total Available N	9.2	75-150	Low
Phosphorous(P_2O_5)	130	100-300	OK
Potassium (K_2O)	170	450-750	Low
Calcium (Ca)	1400	2000-2500	Low
Magnesium (Mg)	130	300-600	Low
Sulfate (SO_4-S)	3.2	100-200	Low
Sodium (Na)	7.9	< 250	See SAR
Chloride (Cl)	3.6	1-100	OK
ECe (dS/m)	0.16	0.2-4	Low
Copper (Cu)	0.36	1 +	Low
Zinc (Zn)	3.1	3 +	OK
Iron (Fe)	350	8 +	OK
Manganese (Mn)	24	4 +	OK
Boron (B)	0.16	1-4	Low
SAR	0.16	0-6	OK
CEC (meq/100gms)	4.3	10-20	OK
ESP (%)	0.40	0-10	OK
pHs Value	5.7	6.5-7.5	Low
Organic Matter (%)	1.0		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
150	Phosphorous (P_2O_5)
400	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep
needed to raise pH of soil to:

pH 6.0 needs	0.3
pH 6.5 needs	0.8
pH 7.0 needs	1.3

Gypsum Requirement (needed for clay treatment)
0.7 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	3.0	mg/Kg	KCl
NH_3-N	1.6	mg/Kg	KCl
P	30	mg/Kg	Olsen
SP	35	%	Sat
pHs	5.7	unit	Sat
ECe	0.16	dS/m	Sat
Ca	1.4	meq/L	Sat
Mg	0.46	meq/L	Sat
Na	0.16	meq/L	Sat
K	0.16	meq/L	Sat
Cl	0.14	meq/L	Sat
SO_4-S	0.14	meq/L	Sat
SAR	0.16	ratio	Calc
B	0.078	mg/Kg	CaCl2
Cu	0.18	mg/Kg	DTPA
Zn	1.6	mg/Kg	DTPA
Fe	180	mg/Kg	DTPA
Mn	12	mg/Kg	DTPA

Data:			Method
OrgMat	1.0	%	WalkBk
Org-C	0.60	%	WalkBk
SMP Bufffer pH	7.16	unit	SMP
GypReq	0.87	meq/100g	GypSol
Ca	710	mg/Kg	NH_4OAc
Mg	67	mg/Kg	NH_4OAc
Na	4.0	mg/Kg	NH_4OAc
K	70	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	4.3	meq/100gm	Calc.
NH_3-N	0.3	% of CEC	Calc.
Ca	82.2	% of CEC	Calc.
Mg	13.0	% of CEC	Calc.
Na	0.4	% of CEC	Calc.
K	4.1	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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Date Reported: May 5, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040309-13/32
Project #/Name: None / None
Sample ID: EL5-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	2.5	10-50	Low
Nitrate (NO_3-N)	7.0	20-100	Low
Total Available N	9.5	75-150	Low
Phosphorous(P_2O_5)	120	100-300	OK
Potassium (K_2O)	200	450-750	Low
Calcium (Ca)	1400	2000-2500	Low
Magnesium (Mg)	160	300-600	Low
Sulfate (SO_4-S)	3.2	100-200	Low
Sodium (Na)	6.6	< 250	See SAR
Chloride (Cl)	6.5	1-100	OK
ECe (dS/m)	0.14	0.2-4	Low
Copper (Cu)	0.21	1 +	Low
Zinc (Zn)	1.6	3 +	Low
Iron (Fe)	130	8 +	OK
Manganese (Mn)	8.4	4 +	OK
Boron (B)	0.20	1-4	Low
SAR	0.17	0-6	OK
CEC (meq/100gms)	4.4	10-20	OK
ESP (%)	0.33	0-10	OK
pHs Value	6.2	6.5-7.5	Low
Organic Matter (%)	0.83		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
150	Phosphorous (P_2O_5)
400	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.3
pH 7.0 needs	0.8

Gypsum Requirement (needed for clay treatment)
0.9 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	3.5	mg/Kg	KCl
NH_3-N	1.2	mg/Kg	KCl
P	27	mg/Kg	Olsen
SP	35	%	Sat
pHs	6.2	unit	Sat
ECe	0.14	dS/m	Sat
Ca	0.90	meq/L	Sat
Mg	0.33	meq/L	Sat
Na	0.13	meq/L	Sat
K	0.17	meq/L	Sat
Cl	0.26	meq/L	Sat
SO_4-S	0.14	meq/L	Sat
SAR	0.17	ratio	Calc
B	0.10	mg/Kg	CaCl2
Cu	0.11	mg/Kg	DTPA
Zn	0.82	mg/Kg	DTPA
Fe	66	mg/Kg	DTPA
Mn	4.2	mg/Kg	DTPA

Data:			Method
OrgMat	0.83	%	WalkBk
Org-C	0.48	%	WalkBk
SMP Bufffer pH	7.25	unit	SMP
GypReq	1.0	meq/100g	GypSol
Ca	700	mg/Kg	NH_4OAc
Mg	79	mg/Kg	NH_4OAc
Na	3.3	mg/Kg	NH_4OAc
K	83	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	4.4	meq/100gm	Calc.
NH_3-N	0.2	% of CEC	Calc.
Ca	79.7	% of CEC	Calc.
Mg	15.0	% of CEC	Calc.
Na	0.3	% of CEC	Calc.
K	4.8	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040309-14/32
Project #/Name: None / None
Sample ID: EL6-1

	Your Values (lbs/acre 6" deep)	Suggested Values		RECOMMENDATIONS ALL VALUES lbs/acre 6" deep
Ammonia (NH_3-N)	2.0	10-50	Low	125 Nitrogen (N)
Nitrate (NO_3-N)	< 4	20-100	Low	150 Phosphorous (P_2O_5)
Total Available N	2.6	75-150	Low	300 Potassium (K_2O)
Phosphorous(P_2O_5)	150	100-300	OK	0 Gypsum ($CaSO_4$)
Potassium (K_2O)	280	450-750	Low	0 Lime ($CaCO_3$)
Calcium (Ca)	1100	2000-2500	Low	0 Dolomite ($CaCO_3$ & $MgCO_3$)
Magnesium (Mg)	140	300-600	Low	0 Sulfur
Sulfate (SO_4-S)	2.9	100-200	Low	*Gypsum adds Ca and doesn't affect pH; Lime adds Ca
Sodium (Na)	4.8	< 250	See SAR	and raises pH; Dolomite adds Ca & Mg & raises pH.
Chloride (Cl)	3.9	1-100	OK	
ECe (dS/m)	0.13	0.2-4	Low	Lime Requirement:
Copper (Cu)	0.20	1 +	Low	Tons of 100% $CaCO_3$ Lime per Acre 6" deep
Zinc (Zn)	1.2	3 +	Low	needed to raise pH of soil to:
Iron (Fe)	120	8 +	OK	
Manganese (Mn)	7.2	4 +	OK	pH 6.0 needs 0.1
Boron (B)	0.23	1-4	Low	pH 6.5 needs 0.6
SAR	0.14	0-6	OK	pH 7.0 needs 1.1
CEC (meq/100gms)	3.7	10-20	OK	
ESP (%)	0.28	0-10	OK	Gypsum Requirement (needed for clay treatment)
pHs Value	5.9	6.5-7.5	Low	0.6 tons per acre 6" deep
Organic Matter (%)	0.67			Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	< 2	mg/Kg	KCl
NH_3-N	1.0	mg/Kg	KCl
P	33	mg/Kg	Olsen
SP	32	%	Sat
pHs	5.9	unit	Sat
ECe	0.13	dS/m	Sat
Ca	0.83	meq/L	Sat
Mg	0.43	meq/L	Sat
Na	0.11	meq/L	Sat
K	0.34	meq/L	Sat
Cl	0.17	meq/L	Sat
SO_4-S	0.14	meq/L	Sat
SAR	0.14	ratio	Calc
B	0.11	mg/Kg	CaCl2
Cu	0.10	mg/Kg	DTPA
Zn	0.61	mg/Kg	DTPA
Fe	60	mg/Kg	DTPA
Mn	3.6	mg/Kg	DTPA

Data:			Method
OrgMat	0.67	%	WalkBk
Org-C	0.39	%	WalkBk
SMP Bufffer pH	7.22	unit	SMP
GypReq	0.68	meq/100g	GypSol
Ca	570	mg/Kg	NH_4OAc
Mg	71	mg/Kg	NH_4OAc
Na	2.4	mg/Kg	NH_4OAc
K	110	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages			
CEC	3.7	meq/100gm	Calc.
NH_3-N	0.2	% of CEC	Calc.
Ca	75.9	% of CEC	Calc.
Mg	15.8	% of CEC	Calc.
Na	0.3	% of CEC	Calc.
K	7.8	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

ANALYTICAL CHEMISTS and BACTERIOLOGISTS Approved by State of California

SOIL CONTROL LAB

42 HANGAR WAY WATSONVILLE CALIFORNIA 95076 USA

TEL: 831-724-5422
FAX: 831-724-3188

Work Order #: 7040309
Account #: 9690
Date Received: Apr 10, 2017
Date Reported: May 5, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040309-15/32
Project #/Name: None / None
Sample ID: EL7-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	2.5	10-50	Low
Nitrate (NO_3-N)	< 4	20-100	Low
Total Available N	3.4	75-150	Low
Phosphorous(P_2O_5)	120	100-300	OK
Potassium (K_2O)	120	450-750	Low
Calcium (Ca)	1200	2000-2500	Low
Magnesium (Mg)	120	300-600	Low
Sulfate (SO_4-S)	3.0	100-200	Low
Sodium (Na)	4.9	< 250	See SAR
Chloride (Cl)	4.3	1-100	OK
ECe (dS/m)	0.12	0.2-4	Low
Copper (Cu)	0.19	1 +	Low
Zinc (Zn)	1.6	3 +	Low
Iron (Fe)	61	8 +	OK
Manganese (Mn)	7.4	4 +	OK
Boron (B)	0.11	1-4	Low
SAR	0.15	0-6	OK
CEC (meq/100gms)	3.6	10-20	OK
ESP (%)	0.30	0-10	OK
pHs Value	6.2	6.5-7.5	Low
Organic Matter (%)	0.39		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
150	Phosphorous (P_2O_5)
450	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.3
pH 7.0 needs	0.8

Gypsum Requirement (needed for clay treatment)
0.7 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	< 2	mg/Kg	KCl
NH_3-N	1.2	mg/Kg	KCl
P	28	mg/Kg	Olsen
SP	33	%	Sat
pHs	6.2	unit	Sat
ECe	0.12	dS/m	Sat
Ca	0.90	meq/L	Sat
Mg	0.37	meq/L	Sat
Na	0.12	meq/L	Sat
K	0.11	meq/L	Sat
Cl	0.18	meq/L	Sat
SO_4-S	0.14	meq/L	Sat
SAR	0.15	ratio	Calc
B	0.057	mg/Kg	CaCl2
Cu	0.097	mg/Kg	DTPA
Zn	0.78	mg/Kg	DTPA
Fe	30	mg/Kg	DTPA
Mn	3.7	mg/Kg	DTPA

Data:			Method
OrgMat	0.39	%	WalkBk
Org-C	0.22	%	WalkBk
SMP Bufffer pH	7.31	unit	SMP
GypReq	0.84	meq/100g	GypSol
Ca	590	mg/Kg	NH_4OAc
Mg	60	mg/Kg	NH_4OAc
Na	2.5	mg/Kg	NH_4OAc
K	51	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	3.6	meq/100gm	Calc.
NH_3-N	0.2	% of CEC	Calc.
Ca	81.8	% of CEC	Calc.
Mg	14.0	% of CEC	Calc.
Na	0.3	% of CEC	Calc.
K	3.7	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

ANALYTICAL CHEMISTS and BACTERIOLOGISTS Approved by State of California

SOIL CONTROL LAB

42 HANGAR WAY WATSONVILLE CALIFORNIA 95076 USA

TEL: 831-724-5422
FAX: 831-724-3188

Work Order #: 7040309
Account #: 9690
Date Received: Apr 10, 2017
Date Reported: May 5, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040309-16/32
Project #/Name: None / None
Sample ID: EL8-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	2.1	10-50	Low
Nitrate (NO_3-N)	11	20-100	Low
Total Available N	13	75-150	Low
Phosphorous(P_2O_5)	150	100-300	OK
Potassium (K_2O)	190	450-750	Low
Calcium (Ca)	1400	2000-2500	Low
Magnesium (Mg)	170	300-600	Low
Sulfate (SO_4-S)	4.2	100-200	Low
Sodium (Na)	12	< 250	See SAR
Chloride (Cl)	4.3	1-100	OK
ECe (dS/m)	0.14	0.2-4	Low
Copper (Cu)	0.27	1 +	Low
Zinc (Zn)	1.9	3 +	Low
Iron (Fe)	150	8 +	OK
Manganese (Mn)	11	4 +	OK
Boron (B)	0.11	1-4	Low
SAR	0.57	0-6	OK
CEC (meq/100gms)	4.5	10-20	OK
ESP (%)	0.58	0-10	OK
pHs Value	5.9	6.5-7.5	Low
Organic Matter (%)	1.0		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
150	Phosphorous (P_2O_5)
400	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.1
pH 6.5 needs	0.6
pH 7.0 needs	1.1

Gypsum Requirement (needed for clay treatment)
0.8 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	5.7	mg/Kg	KCl
NH_3-N	1.0	mg/Kg	KCl
P	34	mg/Kg	Olsen
SP	40	%	Sat
pHs	5.9	unit	Sat
ECe	0.14	dS/m	Sat
Ca	0.83	meq/L	Sat
Mg	0.38	meq/L	Sat
Na	0.44	meq/L	Sat
K	0.17	meq/L	Sat
Cl	0.15	meq/L	Sat
SO_4-S	0.16	meq/L	Sat
SAR	0.57	ratio	Calc
B	0.054	mg/Kg	CaCl2
Cu	0.14	mg/Kg	DTPA
Zn	0.94	mg/Kg	DTPA
Fe	73	mg/Kg	DTPA
Mn	5.3	mg/Kg	DTPA

Data:			Method
OrgMat	1.0	%	WalkBk
Org-C	0.59	%	WalkBk
SMP Bufffer pH	7.14	unit	SMP
GypReq	0.95	meq/100g	GypSol
Ca	710	mg/Kg	NH_4OAc
Mg	83	mg/Kg	NH_4OAc
Na	5.9	mg/Kg	NH_4OAc
K	79	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	4.5	meq/100gm	Calc.
NH_3-N	0.2	% of CEC	Calc.
Ca	79.3	% of CEC	Calc.
Mg	15.4	% of CEC	Calc.
Na	0.6	% of CEC	Calc.
K	4.5	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

42 HANGAR WAY WATSONVILLE CALIFORNIA 95076 USA

TEL: 831-724-5422
FAX: 831-724-3188

Work Order #: 7040309
Account #: 9690
Date Received: Apr 10, 2017
Date Reported: May 5, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040309-17/32
Project #/Name: None / None
Sample ID: EL9-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	6.4	10-50	Low
Nitrate (NO_3-N)	4.5	20-100	Low
Total Available N	11	75-150	Low
Phosphorous(P_2O_5)	130	100-300	OK
Potassium (K_2O)	520	450-750	OK
Calcium (Ca)	3900	3238-4048	OK
Magnesium (Mg)	760	323-647	High
Sulfate (SO_4-S)	11	100-200	Low
Sodium (Na)	24	< 250	See SAR
Chloride (Cl)	13	1-100	OK
ECe (dS/m)	0.22	0.2-4	OK
Copper (Cu)	0.75	1 +	Low
Zinc (Zn)	1.4	3 +	Low
Iron (Fe)	58	8 +	OK
Manganese (Mn)	12	4 +	OK
Boron (B)	0.48	1-4	Low
SAR	0.24	0-6	OK
CEC (meq/100gms)	13	10-20	OK
ESP (%)	0.38	0-10	OK
pHs Value	5.8	6.5-7.5	Low
Organic Matter (%)	1.8		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
150	Phosphorous (P_2O_5)
200	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.5
pH 6.5 needs	0.5
pH 7.0 needs	0.6

Gypsum Requirement (needed for clay treatment)
2.4 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	2.3	mg/Kg	KCl
NH_3-N	3.2	mg/Kg	KCl
P	29	mg/Kg	Olsen
SP	55	%	Sat
pHs	5.8	unit	Sat
ECe	0.22	dS/m	Sat
Ca	3.4	meq/L	Sat
Mg	4.5	meq/L	Sat
Na	0.47	meq/L	Sat
K	1.2	meq/L	Sat
Cl	0.33	meq/L	Sat
SO_4-S	0.32	meq/L	Sat
SAR	0.24	ratio	Calc
B	0.24	mg/Kg	CaCl2
Cu	0.38	mg/Kg	DTPA
Zn	0.68	mg/Kg	DTPA
Fe	29	mg/Kg	DTPA
Mn	6.0	mg/Kg	DTPA

Data:			Method
OrgMat	1.8	%	WalkBk
Org-C	1.1	%	WalkBk
SMP Bufffer pH	6.87	unit	SMP
GypReq	2.8	meq/100g	GypSol
Ca	1900	mg/Kg	NH_4OAc
Mg	380	mg/Kg	NH_4OAc
Na	12	mg/Kg	NH_4OAc
K	220	mg/Kg	NH_4OAc
Moisture	NA	%	Oven dry

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	13	meq/100gm	Calc.
NH_3-N	0.2	% of CEC	Calc.
Ca	71.8	% of CEC	Calc.
Mg	23.6	% of CEC	Calc.
Na	0.4	% of CEC	Calc.
K	4.1	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

ANALYTICAL CHEMISTS and BACTERIOLOGISTS Approved by State of California

SOIL CONTROL LAB

42 HANGAR WAY WATSONVILLE CALIFORNIA 95076 USA

TEL: 831-724-5422
FAX: 831-724-3188

Work Order #: 7040309
Account #: 9690
Date Received: Apr 10, 2017
Date Reported: May 5, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040309-18/32
Project #/Name: None / None
Sample ID: EL10-1

	Your Values (lbs/acre 6" deep)	Suggested Values
Ammonia (NH_3-N)	2.4	10-50 Low
Nitrate (NO_3-N)	14	20-100 Low
Total Available N	16	75-150 Low
Phosphorous(P_2O_5)	110	100-300 OK
Potassium (K_2O)	130	450-750 Low
Calcium (Ca)	2000	2000-2500 OK
Magnesium (Mg)	250	300-600 Low
Sulfate (SO_4-S)	2.5	100-200 Low
Sodium (Na)	13	< 250 See SAR
Chloride (Cl)	7.0	1-100 OK
ECe (dS/m)	0.13	0.2-4 Low
Copper (Cu)	0.17	1 + Low
Zinc (Zn)	0.50	3 + Low
Iron (Fe)	34	8 + OK
Manganese (Mn)	4.8	4 + OK
Boron (B)	0.13	1-4 Low
SAR	0.23	0-6 OK
CEC (meq/100gms)	6.2	10-20 OK
ESP (%)	0.45	0-10 OK
pHs Value	6.2	6.5-7.5 Low
Organic Matter (%)	0.61	

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
150	Phosphorous (P_2O_5)
450	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.3
pH 7.0 needs	0.8

Gypsum Requirement (needed for clay treatment)
1.1 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	6.9	mg/Kg	KCl
NH_3-N	1.2	mg/Kg	KCl
P	24	mg/Kg	Olsen
SP	35	%	Sat
pHs	6.2	unit	Sat
ECe	0.13	dS/m	Sat
Ca	0.78	meq/L	Sat
Mg	0.54	meq/L	Sat
Na	0.19	meq/L	Sat
K	0.12	meq/L	Sat
Cl	0.28	meq/L	Sat
SO_4-S	0.11	meq/L	Sat
SAR	0.23	ratio	Calc
B	0.065	mg/Kg	CaCl2
Cu	0.084	mg/Kg	DTPA
Zn	0.25	mg/Kg	DTPA
Fe	17	mg/Kg	DTPA
Mn	2.4	mg/Kg	DTPA

Data:			Method
OrgMat	0.61	%	WalkBk
Org-C	0.36	%	WalkBk
SMP Bufffer pH	7.21	unit	SMP
GypReq	1.3	meq/100g	GypSol
Ca	990	mg/Kg	NH_4OAc
Mg	120	mg/Kg	NH_4OAc
Na	6.3	mg/Kg	NH_4OAc
K	53	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	6.2	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	80.4	% of CEC	Calc.
Mg	16.9	% of CEC	Calc.
Na	0.4	% of CEC	Calc.
K	2.2	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

42 HANGAR WAY
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USA

TEL: 831-724-5422
FAX: 831-724-3188

Work Order #: 7040309
Account #: 9690
Date Received: Apr 10, 2017
Date Reported: May 5, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040309-19/32
Project #/Name: None / None
Sample ID: EL11-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	< 2	10-50	Low
Nitrate (NO_3-N)	9.4	20-100	Low
Total Available N	11	75-150	Low
Phosphorous(P_2O_5)	150	100-300	OK
Potassium (K_2O)	120	450-750	Low
Calcium (Ca)	3100	2183-2729	High
Magnesium (Mg)	270	300-600	Low
Sulfate (SO_4-S)	3.0	100-200	Low
Sodium (Na)	16	< 250	See SAR
Chloride (Cl)	3.6	1-100	OK
ECe (dS/m)	0.14	0.2-4	Low
Copper (Cu)	0.12	1 +	Low
Zinc (Zn)	1.1	3 +	Low
Iron (Fe)	38	8 +	OK
Manganese (Mn)	6.0	4 +	OK
Boron (B)	0.21	1-4	Low
SAR	0.18	0-6	OK
CEC (meq/100gms)	9.1	10-20	OK
ESP (%)	0.39	0-10	OK
pHs Value	6.6	6.5-7.5	OK
Organic Matter (%)	0.88		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
150	Phosphorous (P_2O_5)
450	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.4

Gypsum Requirement (needed for clay treatment)
1.0 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	4.7	mg/Kg	KCl
NH_3-N	< 1	mg/Kg	KCl
P	33	mg/Kg	Olsen
SP	37	%	Sat
pHs	6.6	unit	Sat
ECe	0.14	dS/m	Sat
Ca	1.1	meq/L	Sat
Mg	0.46	meq/L	Sat
Na	0.17	meq/L	Sat
K	0.049	meq/L	Sat
Cl	0.14	meq/L	Sat
SO_4-S	0.12	meq/L	Sat
SAR	0.18	ratio	Calc
B	0.10	mg/Kg	CaCl2
Cu	0.059	mg/Kg	DTPA
Zn	0.55	mg/Kg	DTPA
Fe	19	mg/Kg	DTPA
Mn	3.0	mg/Kg	DTPA

Data:			Method
OrgMat	0.88	%	WalkBk
Org-C	0.51	%	WalkBk
SMP Bufffer pH	7.24	unit	SMP
GypReq	1.2	meq/100g	GypSol
Ca	1600	mg/Kg	NH_4OAc
Mg	130	mg/Kg	NH_4OAc
Na	8.2	mg/Kg	NH_4OAc
K	49	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	9.1	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	86.0	% of CEC	Calc.
Mg	12.2	% of CEC	Calc.
Na	0.4	% of CEC	Calc.
K	1.4	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

42 HANGAR WAY
WATSONVILLE
CALIFORNIA
95076
USA

TEL: 831-724-5422
FAX: 831-724-3188

Work Order #: 7040309
Account #: 9690
Date Received: Apr 10, 2017
Date Reported: May 5, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040309-20/32
Project #/Name: None / None
Sample ID: CM1-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	5.3	10-50	Low
Nitrate (NO_3-N)	7.5	20-100	Low
Total Available N	13	75-150	Low
Phosphorous(P_2O_5)	65	100-300	Low
Potassium (K_2O)	280	504-840	Low
Calcium (Ca)	4800	4297-5371	OK
Magnesium (Mg)	1300	429-859	High
Sulfate (SO_4-S)	8.6	100-200	Low
Sodium (Na)	82	< 250	See SAR
Chloride (Cl)	10	1-100	OK
ECe (dS/m)	0.20	0.2-4	OK
Copper (Cu)	0.42	1 +	Low
Zinc (Zn)	0.30	3 +	Low
Iron (Fe)	24	8 +	OK
Manganese (Mn)	4.0	4 +	Low
Boron (B)	0.33	1-4	Low
SAR	0.36	0-6	OK
CEC (meq/100gms)	18	10-20	OK
ESP (%)	1.0	0-10	OK
pHs Value	6.5	6.5-7.5	OK
Organic Matter (%)	0.42		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
200	Phosphorous (P_2O_5)
350	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.5

Gypsum Requirement (needed for clay treatment)
2.8 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	3.7	mg/Kg	KCl
NH_3-N	2.6	mg/Kg	KCl
P	15	mg/Kg	Olsen
SP	45	%	Sat
pHs	6.5	unit	Sat
ECe	0.20	dS/m	Sat
Ca	4.4	meq/L	Sat
Mg	2.4	meq/L	Sat
Na	0.66	meq/L	Sat
K	0.062	meq/L	Sat
Cl	0.33	meq/L	Sat
SO_4-S	0.30	meq/L	Sat
SAR	0.36	ratio	Calc
B	0.17	mg/Kg	CaCl2
Cu	0.21	mg/Kg	DTPA
Zn	0.15	mg/Kg	DTPA
Fe	12	mg/Kg	DTPA
Mn	2.0	mg/Kg	DTPA

Data:			Method
OrgMat	0.42	%	WalkBk
Org-C	0.24	%	WalkBk
SMP Bufffer pH	7.20	unit	SMP
GypReq	3.3	meq/100g	GypSol
Ca	2400	mg/Kg	NH_4OAc
Mg	640	mg/Kg	NH_4OAc
Na	41	mg/Kg	NH_4OAc
K	120	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	18	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	67.5	% of CEC	Calc.
Mg	29.7	% of CEC	Calc.
Na	1.0	% of CEC	Calc.
K	1.7	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

42 HANGAR WAY WATSONVILLE CALIFORNIA 95076 USA

TEL: 831-724-5422
FAX: 831-724-3188

Work Order #: 7040309
Account #: 9690
Date Received: Apr 10, 2017
Date Reported: May 5, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040309-21/32
Project #/Name: None / None
Sample ID: CM2-1

	Your Values (lbs/acre 6" deep)	Suggested Values
Ammonia (NH_3-N)	6.2	10-50 Low
Nitrate (NO_3-N)	5.0	20-100 Low
Total Available N	11	75-150 Low
Phosphorous(P_2O_5)	70	100-300 Low
Potassium (K_2O)	230	450-750 Low
Calcium (Ca)	3100	2617-3272 OK
Magnesium (Mg)	670	300-600 High
Sulfate (SO_4-S)	6.8	100-200 Low
Sodium (Na)	18	< 250 See SAR
Chloride (Cl)	7.2	1-100 OK
ECe (dS/m)	0.16	0.2-4 Low
Copper (Cu)	0.57	1 + Low
Zinc (Zn)	0.61	3 + Low
Iron (Fe)	24	8 + OK
Manganese (Mn)	5.5	4 + OK
Boron (B)	0.22	1-4 Low
SAR	0.19	0-6 OK
CEC (meq/100gms)	11	10-20 OK
ESP (%)	0.35	0-10 OK
pHs Value	6.3	6.5-7.5 Low
Organic Matter (%)	0.65	

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
200	Phosphorous (P_2O_5)
350	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.2
pH 7.0 needs	0.7

Gypsum Requirement (needed for clay treatment)
2.2 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	2.5	mg/Kg	KCl
NH_3-N	3.1	mg/Kg	KCl
P	16	mg/Kg	Olsen
SP	42	%	Sat
pHs	6.3	unit	Sat
ECe	0.16	dS/m	Sat
Ca	2.0	meq/L	Sat
Mg	1.0	meq/L	Sat
Na	0.23	meq/L	Sat
K	0.078	meq/L	Sat
Cl	0.24	meq/L	Sat
SO_4-S	0.25	meq/L	Sat
SAR	0.19	ratio	Calc
B	0.11	mg/Kg	CaCl2
Cu	0.28	mg/Kg	DTPA
Zn	0.31	mg/Kg	DTPA
Fe	12	mg/Kg	DTPA
Mn	2.8	mg/Kg	DTPA

Data:			Method
OrgMat	0.65	%	WalkBk
Org-C	0.38	%	WalkBk
SMP Bufffer pH	7.16	unit	SMP
GypReq	2.6	meq/100g	GypSol
Ca	1600	mg/Kg	NH_4OAc
Mg	340	mg/Kg	NH_4OAc
Na	8.9	mg/Kg	NH_4OAc
K	95	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	11	meq/100gm	Calc.
NH_3-N	0.2	% of CEC	Calc.
Ca	71.5	% of CEC	Calc.
Mg	25.7	% of CEC	Calc.
Na	0.4	% of CEC	Calc.
K	2.2	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

42 HANGAR WAY
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FAX: 831-724-3188

Work Order #: 7040309
Account #: 9690
Date Received: Apr 10, 2017
Date Reported: May 5, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040309-22/32
Project #/Name: None / None
Sample ID: CM2-2

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	2.5	10-50	Low
Nitrate (NO_3-N)	6.2	20-100	Low
Total Available N	8.6	75-150	Low
Phosphorous(P_2O_5)	80	100-300	Low
Potassium (K_2O)	400	450-750	Low
Calcium (Ca)	1700	2000-2500	Low
Magnesium (Mg)	250	300-600	Low
Sulfate (SO_4-S)	3.5	100-200	Low
Sodium (Na)	14	< 250	See SAR
Chloride (Cl)	4.5	1-100	OK
ECe (dS/m)	0.11	0.2-4	Low
Copper (Cu)	0.63	1 +	Low
Zinc (Zn)	0.59	3 +	Low
Iron (Fe)	25	8 +	OK
Manganese (Mn)	7.6	4 +	OK
Boron (B)	0.23	1-4	Low
SAR	0.20	0-6	OK
CEC (meq/100gms)	5.8	10-20	OK
ESP (%)	0.54	0-10	OK
pHs Value	6.2	6.5-7.5	Low
Organic Matter (%)	0.84		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
200	Phosphorous (P_2O_5)
250	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.3
pH 7.0 needs	0.8

Gypsum Requirement (needed for clay treatment)
1.8 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	3.1	mg/Kg	KCl
NH_3-N	1.2	mg/Kg	KCl
P	18	mg/Kg	Olsen
SP	36	%	Sat
pHs	6.2	unit	Sat
ECe	0.11	dS/m	Sat
Ca	0.90	meq/L	Sat
Mg	0.42	meq/L	Sat
Na	0.16	meq/L	Sat
K	0.26	meq/L	Sat
Cl	0.18	meq/L	Sat
SO_4-S	0.15	meq/L	Sat
SAR	0.20	ratio	Calc
B	0.11	mg/Kg	CaCl2
Cu	0.32	mg/Kg	DTPA
Zn	0.29	mg/Kg	DTPA
Fe	13	mg/Kg	DTPA
Mn	3.8	mg/Kg	DTPA

Data:			Method
OrgMat	0.84	%	WalkBk
Org-C	0.49	%	WalkBk
SMP Bufffer pH	7.20	unit	SMP
GypReq	2.1	meq/100g	GypSol
Ca	860	mg/Kg	NH_4OAc
Mg	130	mg/Kg	NH_4OAc
Na	7.2	mg/Kg	NH_4OAc
K	170	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	5.8	meq/100gm	Calc.
NH_3-N	0.2	% of CEC	Calc.
Ca	73.8	% of CEC	Calc.
Mg	18.2	% of CEC	Calc.
Na	0.5	% of CEC	Calc.
K	7.4	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

42 HANGAR WAY
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Work Order #: 7040309
Account #: 9690
Date Received: Apr 10, 2017
Date Reported: May 5, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040309-23/32
Project #/Name: None / None
Sample ID: CM3-1

	Your Values (lbs/acre 6" deep)	Suggested Values
Ammonia (NH_3-N)	3.8	10-50 Low
Nitrate (NO_3-N)	6.3	20-100 Low
Total Available N	10	75-150 Low
Phosphorous(P_2O_5)	84	100-300 Low
Potassium (K_2O)	240	450-750 Low
Calcium (Ca)	2500	2095-2619 OK
Magnesium (Mg)	530	300-600 OK
Sulfate (SO_4-S)	7.2	100-200 Low
Sodium (Na)	40	< 250 See SAR
Chloride (Cl)	5.2	1-100 OK
ECe (dS/m)	0.13	0.2-4 Low
Copper (Cu)	0.78	1 + Low
Zinc (Zn)	0.18	3 + Low
Iron (Fe)	22	8 + OK
Manganese (Mn)	7.6	4 + OK
Boron (B)	0.27	1-4 Low
SAR	0.37	0-6 OK
CEC (meq/100gms)	8.7	10-20 OK
ESP (%)	1.0	0-10 OK
pHs Value	6.1	6.5-7.5 Low
Organic Matter (%)	0.36	

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
200	Phosphorous (P_2O_5)
350	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.4
pH 7.0 needs	0.9

Gypsum Requirement (needed for clay treatment)
1.8 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	3.2	mg/Kg	KCl
NH_3-N	1.9	mg/Kg	KCl
P	19	mg/Kg	Olsen
SP	36	%	Sat
pHs	6.1	unit	Sat
ECe	0.13	dS/m	Sat
Ca	1.6	meq/L	Sat
Mg	0.83	meq/L	Sat
Na	0.41	meq/L	Sat
K	0.14	meq/L	Sat
Cl	0.20	meq/L	Sat
SO_4-S	0.31	meq/L	Sat
SAR	0.37	ratio	Calc
B	0.14	mg/Kg	CaCl2
Cu	0.39	mg/Kg	DTPA
Zn	0.092	mg/Kg	DTPA
Fe	11	mg/Kg	DTPA
Mn	3.8	mg/Kg	DTPA

Data:			Method
OrgMat	0.36	%	WalkBk
Org-C	0.21	%	WalkBk
SMP Bufffer pH	7.22	unit	SMP
GypReq	2.1	meq/100g	GypSol
Ca	1200	mg/Kg	NH_4OAc
Mg	270	mg/Kg	NH_4OAc
Na	20	mg/Kg	NH_4OAc
K	99	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	8.7	meq/100gm	Calc.
NH_3-N	0.2	% of CEC	Calc.
Ca	70.5	% of CEC	Calc.
Mg	25.4	% of CEC	Calc.
Na	1.0	% of CEC	Calc.
K	2.9	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

42 HANGAR WAY WATSONVILLE CALIFORNIA 95076 USA

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Work Order #: 7040309
Account #: 9690
Date Received: Apr 10, 2017
Date Reported: May 5, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040309-24/32
Project #/Name: None / None
Sample ID: CM5-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	< 2	10-50	Low
Nitrate (NO_3-N)	5.3	20-100	Low
Total Available N	7.2	75-150	Low
Phosphorous(P_2O_5)	72	100-300	Low
Potassium (K_2O)	100	450-750	Low
Calcium (Ca)	1300	2000-2500	Low
Magnesium (Mg)	140	300-600	Low
Sulfate (SO_4-S)	3.5	100-200	Low
Sodium (Na)	27	< 250	See SAR
Chloride (Cl)	3.6	1-100	OK
ECe (dS/m)	0.13	0.2-4	Low
Copper (Cu)	0.36	1 +	Low
Zinc (Zn)	0.31	3 +	Low
Iron (Fe)	13	8 +	OK
Manganese (Mn)	3.2	4 +	Low
Boron (B)	< 0.1	1-4	Low
SAR	0.53	0-6	OK
CEC (meq/100gms)	4.0	10-20	OK
ESP (%)	1.5	0-10	OK
pHs Value	6.5	6.5-7.5	OK
Organic Matter (%)	0.11		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
200	Phosphorous (P_2O_5)
450	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.5

Gypsum Requirement (needed for clay treatment)
0.8 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	2.7	mg/Kg	KCl
NH_3-N	< 1	mg/Kg	KCl
P	16	mg/Kg	Olsen
SP	28	%	Sat
pHs	6.5	unit	Sat
ECe	0.13	dS/m	Sat
Ca	0.78	meq/L	Sat
Mg	0.28	meq/L	Sat
Na	0.39	meq/L	Sat
K	0.068	meq/L	Sat
Cl	0.18	meq/L	Sat
SO_4-S	0.20	meq/L	Sat
SAR	0.53	ratio	Calc
B	< 0.05	mg/Kg	CaCl2
Cu	0.18	mg/Kg	DTPA
Zn	0.16	mg/Kg	DTPA
Fe	6.7	mg/Kg	DTPA
Mn	1.6	mg/Kg	DTPA

Data:			Method
OrgMat	0.11	%	WalkBk
Org-C	0.061	%	WalkBk
SMP Bufffer pH	7.44	unit	SMP
GypReq	0.94	meq/100g	GypSol
Ca	660	mg/Kg	NH_4OAc
Mg	70	mg/Kg	NH_4OAc
Na	14	mg/Kg	NH_4OAc
K	43	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	4.0	meq/100gm	Calc.
NH_3-N	0.2	% of CEC	Calc.
Ca	81.2	% of CEC	Calc.
Mg	14.4	% of CEC	Calc.
Na	1.5	% of CEC	Calc.
K	2.8	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040309-25/32
Project #/Name: None / None
Sample ID: CM6-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	2.3	10-50	Low
Nitrate (NO_3-N)	< 4	20-100	Low
Total Available N	6.1	75-150	Low
Phosphorous(P_2O_5)	94	100-300	Low
Potassium (K_2O)	140	450-750	Low
Calcium (Ca)	2400	2000-2500	OK
Magnesium (Mg)	150	300-600	Low
Sulfate (SO_4-S)	2.4	100-200	Low
Sodium (Na)	11	< 250	See SAR
Chloride (Cl)	3.3	1-100	OK
ECe (dS/m)	0.16	0.2-4	Low
Copper (Cu)	0.72	1 +	Low
Zinc (Zn)	0.61	3 +	Low
Iron (Fe)	21	8 +	OK
Manganese (Mn)	4.4	4 +	OK
Boron (B)	0.13	1-4	Low
SAR	0.20	0-6	OK
CEC (meq/100gms)	6.8	10-20	OK
ESP (%)	0.36	0-10	OK
pHs Value	6.7	6.5-7.5	OK
Organic Matter (%)	0.33		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
200	Phosphorous (P_2O_5)
450	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep
needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.3

Gypsum Requirement (needed for clay treatment)
0.9 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	< 2	mg/Kg	KCl
NH_3-N	1.2	mg/Kg	KCl
P	21	mg/Kg	Olsen
SP	28	%	Sat
pHs	6.7	unit	Sat
ECe	0.16	dS/m	Sat
Ca	1.4	meq/L	Sat
Mg	0.41	meq/L	Sat
Na	0.19	meq/L	Sat
K	0.10	meq/L	Sat
Cl	0.16	meq/L	Sat
SO_4-S	0.13	meq/L	Sat
SAR	0.20	ratio	Calc
B	0.063	mg/Kg	CaCl2
Cu	0.36	mg/Kg	DTPA
Zn	0.30	mg/Kg	DTPA
Fe	10	mg/Kg	DTPA
Mn	2.2	mg/Kg	DTPA

Data:			Method
OrgMat	0.33	%	WalkBk
Org-C	0.19	%	WalkBk
SMP Bufffer pH	7.43	unit	SMP
GypReq	1.1	meq/100g	GypSol
Ca	1200	mg/Kg	NH_4OAc
Mg	77	mg/Kg	NH_4OAc
Na	5.6	mg/Kg	NH_4OAc
K	59	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	6.8	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	87.9	% of CEC	Calc.
Mg	9.4	% of CEC	Calc.
Na	0.4	% of CEC	Calc.
K	2.2	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040309-26/32
Project #/Name: None / None
Sample ID: CM7-1

	Your Values (lbs/acre 6" deep)	Suggested Values
Ammonia (NH_3-N)	3.6	10-50 Low
Nitrate (NO_3-N)	4.5	20-100 Low
Total Available N	8.1	75-150 Low
Phosphorous(P_2O_5)	68	100-300 Low
Potassium (K_2O)	170	450-750 Low
Calcium (Ca)	2500	2065-2582 OK
Magnesium (Mg)	530	300-600 OK
Sulfate (SO_4-S)	3.2	100-200 Low
Sodium (Na)	24	< 250 See SAR
Chloride (Cl)	5.8	1-100 OK
ECe (dS/m)	0.13	0.2-4 Low
Copper (Cu)	0.60	1 + Low
Zinc (Zn)	0.44	3 + Low
Iron (Fe)	28	8 + OK
Manganese (Mn)	9.8	4 + OK
Boron (B)	0.40	1-4 Low
SAR	0.52	0-6 OK
CEC (meq/100gms)	8.6	10-20 OK
ESP (%)	0.59	0-10 OK
pHs Value	6.2	6.5-7.5 Low
Organic Matter (%)	0.59	

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
200	Phosphorous (P_2O_5)
400	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.3
pH 7.0 needs	0.8

Gypsum Requirement (needed for clay treatment)
1.8 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	2.2	mg/Kg	KCl
NH_3-N	1.8	mg/Kg	KCl
P	15	mg/Kg	Olsen
SP	36	%	Sat
pHs	6.2	unit	Sat
ECe	0.13	dS/m	Sat
Ca	0.85	meq/L	Sat
Mg	0.53	meq/L	Sat
Na	0.44	meq/L	Sat
K	0.060	meq/L	Sat
Cl	0.23	meq/L	Sat
SO_4-S	0.14	meq/L	Sat
SAR	0.52	ratio	Calc
B	0.20	mg/Kg	CaCl2
Cu	0.30	mg/Kg	DTPA
Zn	0.22	mg/Kg	DTPA
Fe	14	mg/Kg	DTPA
Mn	4.9	mg/Kg	DTPA

Data:			Method
OrgMat	0.59	%	WalkBk
Org-C	0.34	%	WalkBk
SMP Bufffer pH	7.19	unit	SMP
GypReq	2.1	meq/100g	GypSol
Ca	1200	mg/Kg	NH_4OAc
Mg	260	mg/Kg	NH_4OAc
Na	12	mg/Kg	NH_4OAc
K	71	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	8.6	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	71.5	% of CEC	Calc.
Mg	25.6	% of CEC	Calc.
Na	0.6	% of CEC	Calc.
K	2.1	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

ANALYTICAL CHEMISTS
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SOIL CONTROL LAB

42 HANGAR WAY
WATSONVILLE
CALIFORNIA
95076
USA

TEL: 831-724-5422
FAX: 831-724-3188

Work Order #: 7040309
Account #: 9690
Date Received: Apr 10, 2017
Date Reported: May 5, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040309-27/32
Project #/Name: None / None
Sample ID: CM7-2

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	5.4	10-50	Low
Nitrate (NO_3-N)	5.2	20-100	Low
Total Available N	11	75-150	Low
Phosphorous(P_2O_5)	120	100-300	OK
Potassium (K_2O)	300	450-750	Low
Calcium (Ca)	2000	2000-2500	OK
Magnesium (Mg)	300	300-600	OK
Sulfate (SO_4-S)	3.8	100-200	Low
Sodium (Na)	11	< 250	See SAR
Chloride (Cl)	5.3	1-100	OK
ECe (dS/m)	0.11	0.2-4	Low
Copper (Cu)	0.88	1 +	Low
Zinc (Zn)	1.7	3 +	Low
Iron (Fe)	51	8 +	OK
Manganese (Mn)	14	4 +	OK
Boron (B)	0.16	1-4	Low
SAR	0.17	0-6	OK
CEC (meq/100gms)	6.7	10-20	OK
ESP (%)	0.35	0-10	OK
pHs Value	5.7	6.5-7.5	Low
Organic Matter (%)	1.2		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
150	Phosphorous (P_2O_5)
250	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.3
pH 6.5 needs	0.8
pH 7.0 needs	1.3

Gypsum Requirement (needed for clay treatment)
1.0 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	2.6	mg/Kg	KCl
NH_3-N	2.7	mg/Kg	KCl
P	27	mg/Kg	Olsen
SP	41	%	Sat
pHs	5.7	unit	Sat
ECe	0.11	dS/m	Sat
Ca	0.89	meq/L	Sat
Mg	0.34	meq/L	Sat
Na	0.14	meq/L	Sat
K	0.14	meq/L	Sat
Cl	0.18	meq/L	Sat
SO_4-S	0.14	meq/L	Sat
SAR	0.17	ratio	Calc
B	0.081	mg/Kg	CaCl2
Cu	0.44	mg/Kg	DTPA
Zn	0.83	mg/Kg	DTPA
Fe	25	mg/Kg	DTPA
Mn	7.0	mg/Kg	DTPA

Data:			Method
OrgMat	1.2	%	WalkBk
Org-C	0.71	%	WalkBk
SMP Bufffer pH	7.05	unit	SMP
GypReq	1.2	meq/100g	GypSol
Ca	1000	mg/Kg	NH_4OAc
Mg	150	mg/Kg	NH_4OAc
Na	5.4	mg/Kg	NH_4OAc
K	130	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	6.7	meq/100gm	Calc.
NH_3-N	0.3	% of CEC	Calc.
Ca	76.0	% of CEC	Calc.
Mg	18.5	% of CEC	Calc.
Na	0.4	% of CEC	Calc.
K	4.8	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

ANALYTICAL CHEMISTS and BACTERIOLOGISTS Approved by State of California

SOIL CONTROL LAB

42 HANGAR WAY WATSONVILLE CALIFORNIA 95076 USA

TEL: 831-724-5422
FAX: 831-724-3188

Work Order #: 7040309
Account #: 9690
Date Received: Apr 10, 2017
Date Reported: May 5, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040309-28/32
Project #/Name: None / None
Sample ID: CM8-1

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	2.6	10-50	Low
Nitrate (NO_3-N)	< 4	20-100	Low
Total Available N	4.2	75-150	Low
Phosphorous(P_2O_5)	84	100-300	Low
Potassium (K_2O)	260	450-750	Low
Calcium (Ca)	1800	2000-2500	Low
Magnesium (Mg)	320	300-600	OK
Sulfate (SO_4-S)	3.0	100-200	Low
Sodium (Na)	18	< 250	See SAR
Chloride (Cl)	4.7	1-100	OK
ECe (dS/m)	0.10	0.2-4	Low
Copper (Cu)	0.77	1 +	Low
Zinc (Zn)	0.36	3 +	Low
Iron (Fe)	22	8 +	OK
Manganese (Mn)	5.0	4 +	OK
Boron (B)	0.22	1-4	Low
SAR	0.21	0-6	OK
CEC (meq/100gms)	6.3	10-20	OK
ESP (%)	0.62	0-10	OK
pHs Value	6.2	6.5-7.5	Low
Organic Matter (%)	0.37		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
200	Phosphorous (P_2O_5)
300	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.4
pH 7.0 needs	0.9

Gypsum Requirement (needed for clay treatment)
1.1 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	< 2	mg/Kg	KCl
NH_3-N	1.3	mg/Kg	KCl
P	19	mg/Kg	Olsen
SP	32	%	Sat
pHs	6.2	unit	Sat
ECe	0.10	dS/m	Sat
Ca	1.7	meq/L	Sat
Mg	0.68	meq/L	Sat
Na	0.23	meq/L	Sat
K	0.19	meq/L	Sat
Cl	0.21	meq/L	Sat
SO_4-S	0.15	meq/L	Sat
SAR	0.21	ratio	Calc
B	0.11	mg/Kg	CaCl2
Cu	0.38	mg/Kg	DTPA
Zn	0.18	mg/Kg	DTPA
Fe	11	mg/Kg	DTPA
Mn	2.5	mg/Kg	DTPA

Data:			Method
OrgMat	0.37	%	WalkBk
Org-C	0.21	%	WalkBk
SMP Bufffer pH	7.24	unit	SMP
GypReq	1.3	meq/100g	GypSol
Ca	920	mg/Kg	NH_4OAc
Mg	160	mg/Kg	NH_4OAc
Na	8.9	mg/Kg	NH_4OAc
K	110	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	6.3	meq/100gm	Calc.
NH_3-N	0.2	% of CEC	Calc.
Ca	73.6	% of CEC	Calc.
Mg	21.3	% of CEC	Calc.
Na	0.6	% of CEC	Calc.
K	4.3	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

42 HANGAR WAY WATSONVILLE CALIFORNIA 95076 USA

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Work Order #: 7040309
Account #: 9690
Date Received: Apr 10, 2017
Date Reported: May 5, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040309-29/32
Project #/Name: None / None
Sample ID: CM8-2

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	2.6	10-50	Low
Nitrate (NO_3-N)	< 4	20-100	Low
Total Available N	3.6	75-150	Low
Phosphorous(P_2O_5)	84	100-300	Low
Potassium (K_2O)	190	450-750	Low
Calcium (Ca)	3100	2339-2924	High
Magnesium (Mg)	420	300-600	OK
Sulfate (SO_4-S)	2.8	100-200	Low
Sodium (Na)	36	< 250	See SAR
Chloride (Cl)	4.9	1-100	OK
ECe (dS/m)	0.11	0.2-4	Low
Copper (Cu)	0.86	1 +	Low
Zinc (Zn)	0.15	3 +	Low
Iron (Fe)	18	8 +	OK
Manganese (Mn)	4.2	4 +	OK
Boron (B)	0.34	1-4	Low
SAR	0.35	0-6	OK
CEC (meq/100gms)	9.7	10-20	OK
ESP (%)	0.80	0-10	OK
pHs Value	6.7	6.5-7.5	OK
Organic Matter (%)	0.25		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
200	Phosphorous (P_2O_5)
400	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.0
pH 7.0 needs	0.3

Gypsum Requirement (needed for clay treatment)
1.6 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	< 2	mg/Kg	KCl
NH_3-N	1.3	mg/Kg	KCl
P	19	mg/Kg	Olsen
SP	35	%	Sat
pHs	6.7	unit	Sat
ECe	0.11	dS/m	Sat
Ca	1.1	meq/L	Sat
Mg	0.46	meq/L	Sat
Na	0.31	meq/L	Sat
K	0.058	meq/L	Sat
Cl	0.20	meq/L	Sat
SO_4-S	0.12	meq/L	Sat
SAR	0.35	ratio	Calc
B	0.17	mg/Kg	CaCl2
Cu	0.43	mg/Kg	DTPA
Zn	0.073	mg/Kg	DTPA
Fe	8.9	mg/Kg	DTPA
Mn	2.1	mg/Kg	DTPA

Data:			Method
OrgMat	0.25	%	WalkBk
Org-C	0.14	%	WalkBk
SMP Bufffer pH	7.28	unit	SMP
GypReq	1.9	meq/100g	GypSol
Ca	1500	mg/Kg	NH_4OAc
Mg	210	mg/Kg	NH_4OAc
Na	18	mg/Kg	NH_4OAc
K	79	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	9.7	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	79.2	% of CEC	Calc.
Mg	17.8	% of CEC	Calc.
Na	0.8	% of CEC	Calc.
K	2.1	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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SOIL CONTROL LAB

42 HANGAR WAY WATSONVILLE CALIFORNIA 95076 USA

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Work Order #: 7040309
Account #: 9690
Date Received: Apr 10, 2017
Date Reported: May 5, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040309-30/32
Project #/Name: None / None
Sample ID: CM9-1

	Your Values (lbs/acre 6" deep)	Suggested Values	RECOMMENDATIONS ALL VALUES lbs/acre 6" deep
Ammonia (NH_3-N)	2.3	10-50 Low	125 Nitrogen (N)
Nitrate (NO_3-N)	< 4	20-100 Low	150 Phosphorous (P_2O_5)
Total Available N	2.6	75-150 Low	200 Potassium (K_2O)
Phosphorous(P_2O_5)	140	100-300 OK	0 Gypsum ($CaSO_4$)
Potassium (K_2O)	580	450-750 OK	0 Lime ($CaCO_3$)
Calcium (Ca)	1600	2000-2500 Low	0 Dolomite ($CaCO_3$ & $MgCO_3$)
Magnesium (Mg)	230	300-600 Low	0 Sulfur
Sulfate (SO_4-S)	3.5	100-200 Low	*Gypsum adds Ca and doesn't affect pH; Lime adds Ca
Sodium (Na)	12	< 250 See SAR	and raises pH; Dolomite adds Ca & Mg & raises pH.
Chloride (Cl)	5.5	1-100 OK	
ECe (dS/m)	0.12	0.2-4 Low	Lime Requirement:
Copper (Cu)	0.92	1 + Low	Tons of 100% $CaCO_3$ Lime per Acre 6" deep
Zinc (Zn)	1.1	3 + Low	needed to raise pH of soil to:
Iron (Fe)	71	8 + OK	
Manganese (Mn)	9.2	4 + OK	pH 6.0 needs 0.0
Boron (B)	0.36	1-4 Low	pH 6.5 needs 0.3
SAR	0.21	0-6 OK	pH 7.0 needs 0.8
CEC (meq/100gms)	5.7	10-20 OK	
ESP (%)	0.45	0-10 OK	Gypsum Requirement (needed for clay treatment)
pHs Value	6.2	6.5-7.5 Low	1.3 tons per acre 6" deep
Organic Matter (%)	0.83		Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	< 2	mg/Kg	KCl
NH_3-N	1.2	mg/Kg	KCl
P	31	mg/Kg	Olsen
SP	38	%	Sat
pHs	6.2	unit	Sat
ECe	0.12	dS/m	Sat
Ca	0.79	meq/L	Sat
Mg	0.31	meq/L	Sat
Na	0.15	meq/L	Sat
K	0.33	meq/L	Sat
Cl	0.20	meq/L	Sat
SO_4-S	0.14	meq/L	Sat
SAR	0.21	ratio	Calc
B	0.18	mg/Kg	CaCl2
Cu	0.46	mg/Kg	DTPA
Zn	0.57	mg/Kg	DTPA
Fe	36	mg/Kg	DTPA
Mn	4.6	mg/Kg	DTPA

Data:			Method
OrgMat	0.83	%	WalkBk
Org-C	0.48	%	WalkBk
SMP Bufffer pH	7.18	unit	SMP
GypReq	1.6	meq/100g	GypSol
Ca	820	mg/Kg	NH_4OAc
Mg	110	mg/Kg	NH_4OAc
Na	5.8	mg/Kg	NH_4OAc
K	240	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	5.7	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	71.9	% of CEC	Calc.
Mg	16.6	% of CEC	Calc.
Na	0.4	% of CEC	Calc.
K	10.9	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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Work Order #: 7040309
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Date Received: Apr 10, 2017
Date Reported: May 5, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040309-31/32
Project #/Name: None / None
Sample ID: CM10-1

	Your Values (lbs/acre 6" deep)	Suggested Values
Ammonia (NH_3-N)	2.6	10-50 Low
Nitrate (NO_3-N)	< 4	20-100 Low
Total Available N	6.0	75-150 Low
Phosphorous(P_2O_5)	130	100-300 OK
Potassium (K_2O)	430	450-750 Low
Calcium (Ca)	2100	2000-2500 OK
Magnesium (Mg)	320	300-600 OK
Sulfate (SO_4-S)	3.0	100-200 Low
Sodium (Na)	16	< 250 See SAR
Chloride (Cl)	5.7	1-100 OK
ECe (dS/m)	0.11	0.2-4 Low
Copper (Cu)	0.95	1 + Low
Zinc (Zn)	0.59	3 + Low
Iron (Fe)	29	8 + OK
Manganese (Mn)	7.6	4 + OK
Boron (B)	0.28	1-4 Low
SAR	0.19	0-6 OK
CEC (meq/100gms)	7.1	10-20 OK
ESP (%)	0.48	0-10 OK
pHs Value	6.2	6.5-7.5 Low
Organic Matter (%)	0.66	

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
150	Phosphorous (P_2O_5)
250	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.3
pH 7.0 needs	0.8

Gypsum Requirement (needed for clay treatment)
1.2 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	< 2	mg/Kg	KCl
NH_3-N	1.3	mg/Kg	KCl
P	30	mg/Kg	Olsen
SP	37	%	Sat
pHs	6.2	unit	Sat
ECe	0.11	dS/m	Sat
Ca	1.2	meq/L	Sat
Mg	0.49	meq/L	Sat
Na	0.17	meq/L	Sat
K	0.22	meq/L	Sat
Cl	0.22	meq/L	Sat
SO_4-S	0.13	meq/L	Sat
SAR	0.19	ratio	Calc
B	0.14	mg/Kg	CaCl2
Cu	0.47	mg/Kg	DTPA
Zn	0.30	mg/Kg	DTPA
Fe	15	mg/Kg	DTPA
Mn	3.8	mg/Kg	DTPA

Data:			Method
OrgMat	0.66	%	WalkBk
Org-C	0.39	%	WalkBk
SMP Bufffer pH	7.18	unit	SMP
GypReq	1.4	meq/100g	GypSol
Ca	1000	mg/Kg	NH_4OAc
Mg	160	mg/Kg	NH_4OAc
Na	7.8	mg/Kg	NH_4OAc
K	180	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	7.1	meq/100gm	Calc.
NH_3-N	0.1	% of CEC	Calc.
Ca	74.1	% of CEC	Calc.
Mg	18.9	% of CEC	Calc.
Na	0.5	% of CEC	Calc.
K	6.4	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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Date Received: Apr 10, 2017
Date Reported: May 5, 2017

Soil Report

Dudek
605 3rd Street
Encinitas, CA 92024
Attn: Andy Thomson

Lab Number: 7040309-32/32
Project #/Name: None / None
Sample ID: CM10-2

	Your Values (lbs/acre 6" deep)	Suggested Values	
Ammonia (NH_3-N)	2.9	10-50	Low
Nitrate (NO_3-N)	< 4	20-100	Low
Total Available N	4.5	75-150	Low
Phosphorous(P_2O_5)	49	100-300	Low
Potassium (K_2O)	330	648-1081	Low
Calcium (Ca)	5700	5525-6906	OK
Magnesium (Mg)	1900	552-1105	High
Sulfate (SO_4-S)	6.5	100-200	Low
Sodium (Na)	220	< 250	See SAR
Chloride (Cl)	8.9	1-100	OK
ECe (dS/m)	0.17	0.2-4	Low
Copper (Cu)	0.59	1 +	Low
Zinc (Zn)	0.18	3 +	Low
Iron (Fe)	23	8 +	OK
Manganese (Mn)	3.4	4 +	Low
Boron (B)	0.46	1-4	Low
SAR	0.59	0-6	OK
CEC (meq/100gms)	23	10-20	OK
ESP (%)	2.1	0-10	OK
pHs Value	6.4	6.5-7.5	Low
Organic Matter (%)	0.50		

RECOMMENDATIONS
ALL VALUES lbs/acre 6" deep

125	Nitrogen (N)
250	Phosphorous (P_2O_5)
500	Potassium (K_2O)
0	Gypsum ($CaSO_4$)
0	Lime ($CaCO_3$)
0	Dolomite ($CaCO_3$ & $MgCO_3$)
0	Sulfur

*Gypsum adds Ca and doesn't affect pH; Lime adds Ca and raises pH; Dolomite adds Ca & Mg & raises pH.

Lime Requirement:
Tons of 100% $CaCO_3$ Lime per Acre 6" deep needed to raise pH of soil to:

pH 6.0 needs	0.0
pH 6.5 needs	0.1
pH 7.0 needs	0.6

Gypsum Requirement (needed for clay treatment)
3.3 tons per acre 6" deep
Gypsum helps the soil structure by "loosening" the soil

Data:			Method
NO_3-N	< 2	mg/Kg	KCl
NH_3-N	1.4	mg/Kg	KCl
P	11	mg/Kg	Olsen
SP	40	%	Sat
pHs	6.4	unit	Sat
ECe	0.17	dS/m	Sat
Ca	3.3	meq/L	Sat
Mg	2.3	meq/L	Sat
Na	1.0	meq/L	Sat
K	0.068	meq/L	Sat
Cl	0.31	meq/L	Sat
SO_4-S	0.25	meq/L	Sat
SAR	0.59	ratio	Calc
B	0.23	mg/Kg	CaCl2
Cu	0.29	mg/Kg	DTPA
Zn	0.089	mg/Kg	DTPA
Fe	12	mg/Kg	DTPA
Mn	1.7	mg/Kg	DTPA

Data:			Method
OrgMat	0.50	%	WalkBk
Org-C	0.29	%	WalkBk
SMP Bufffer pH	7.14	unit	SMP
GypReq	3.9	meq/100g	GypSol
Ca	2900	mg/Kg	NH_4OAc
Mg	950	mg/Kg	NH_4OAc
Na	110	mg/Kg	NH_4OAc
K	140	mg/Kg	NH_4OAc

Cation Exchange Capacity (CEC) and Base Saturation Percentages

CEC	23	meq/100gm	Calc.
NH_3-N	0.0	% of CEC	Calc.
Ca	61.9	% of CEC	Calc.
Mg	34.4	% of CEC	Calc.
Na	2.1	% of CEC	Calc.
K	1.5	% of CEC	Calc.
H	0.0	% of CEC	Calc.

Lab Analyst: Mike Galloway

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Dudek
605 3rd Street
Encinitas, CA 92024
Andy Thomson

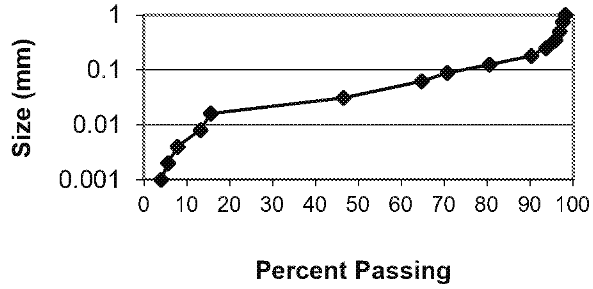
May 5, 2017

Particle Size Distribution

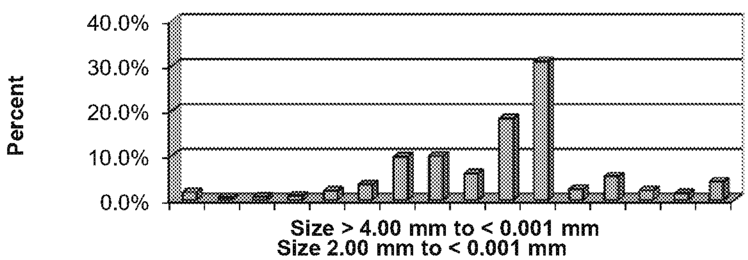
LABORATORY #: 7040309-1/32
IDENTIFICATION: VS1-1
DATE RECEIVED: April 10, 2017

*Gravel and stones are removed first

SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	1.8%	1.8%
1 to 0.75		0.6%	2.4%
0.75-0.50		0.8%	3.2%
0.50-0.35		1.0%	4.1%
0.35-0.25		2.1%	6.2%
0.25-0.18		3.5%	9.7%
0.18-0.125		9.7%	19.4%
0.125-0.088		9.8%	29.3%
0.088-0.062		6.0%	35.2%
0.062-0.031	Silt	18.2%	53.5%
0.031-0.016		30.9%	84.4%
0.016-0.008		2.4%	86.8%
0.008-0.004		5.3%	92.1%
0.004-0.002		2.2%	94.4%
0.002-0.001	Clay	1.5%	95.9%
< 0.001		4.1%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		0.8%	-



Very Coarse Sand %	1.8%		
Coarse Sand %	1.3%		
Medium Sand %	3.1%		
Fine Sand %	23.0%		
Very Fine Sand %	6.0%		
Classification:	**Silty Loam**		
Sand	35.2%		
Silt	59.1%		
Clay	5.6%		
Effective Size (mm):	10%	=	0.0056
	60%	=	0.0539
Uniformity Coeff. (60%/10%)		=	9.62



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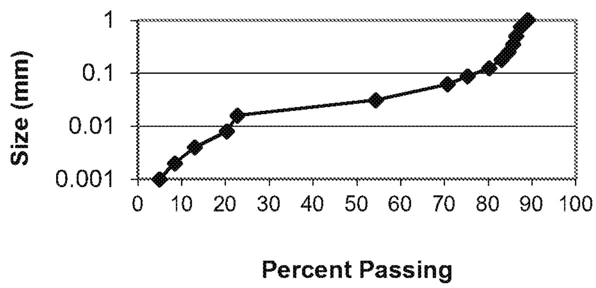
May 5, 2017

Particle Size Distribution

LABORATORY #: 7040309-2/32
IDENTIFICATION: VS2-1
DATE RECEIVED: April 10, 2017



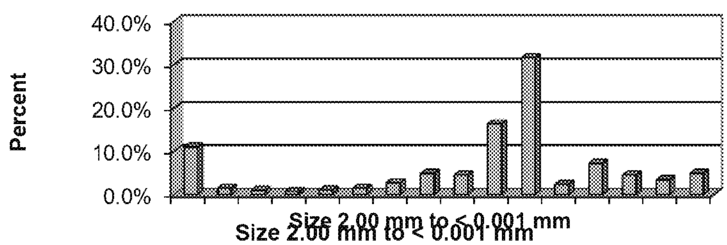
*Gravel and stones are removed first

SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	11.0%	11.0%
1 to 0.75		1.5%	12.5%
0.75-0.50		1.0%	13.6%
0.50-0.35		0.7%	14.3%
0.35-0.25		1.1%	15.4%
0.25-0.18		1.5%	16.9%
0.18-0.125		2.8%	19.8%
0.125-0.088		4.9%	24.7%
0.088-0.062		4.6%	29.2%
0.062-0.031	Silt	16.4%	45.6%
0.031-0.016		31.6%	77.3%
0.016-0.008		2.4%	79.7%
0.008-0.004		7.3%	87.0%
0.004-0.002		4.6%	91.6%
0.002-0.001	Clay	3.5%	95.1%
< 0.001		4.9%	100.0%

*Gravel % based on whole sample (nothing removed)

Gravel		27.8%	-

Very Coarse Sand %	11.0%		
Coarse Sand %	2.6%		
Medium Sand %	1.9%		
Fine Sand %	9.3%		
Very Fine Sand %	4.6%		
Classification:	**Silty Loam**		
Sand	29.2%		
Silt	62.3%		
Clay	8.4%		
Effective Size (mm):	10%	=	0.0027
	60%	=	0.0417
Uniformity Coeff. (60%/10%)		=	15.52



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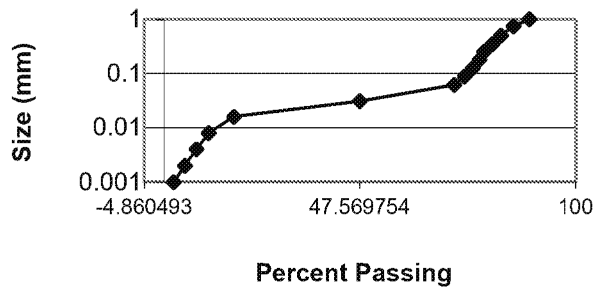
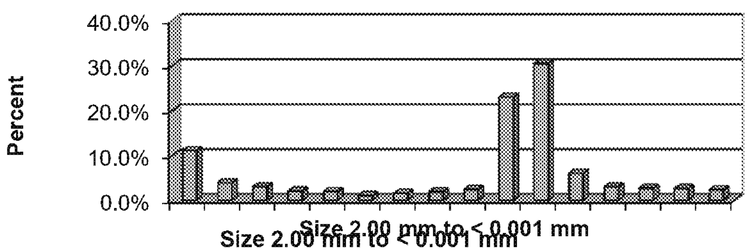
Particle Size Distribution

LABORATORY #: 7040309-3/32
IDENTIFICATION: VS3-1
DATE RECEIVED: April 10, 2017

*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	11.2%	11.2%
1 to 0.75		4.0%	15.1%
0.75-0.50		3.1%	18.2%
0.50-0.35		2.1%	20.3%
0.35-0.25		2.0%	22.3%
0.25-0.18		1.1%	23.4%
0.18-0.125		1.6%	25.1%
0.125-0.088		1.9%	27.0%
0.088-0.062		2.5%	29.5%
0.062-0.031	Silt	23.0%	52.5%
0.031-0.016		30.5%	83.0%
0.016-0.008		6.1%	89.1%
0.008-0.004		3.1%	92.2%
0.004-0.002		2.7%	94.9%
0.002-0.001	Clay	2.7%	97.6%
< 0.001		2.4%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		69.4%	-



Very Coarse Sand %	11.2%		
Coarse Sand %	7.0%		
Medium Sand %	4.1%		
Fine Sand %	4.7%		
Very Fine Sand %	2.5%		
Classification:	**Silty Loam**		
Sand	29.5%		
Silt	65.4%		
Clay	5.1%		
Effective Size (mm):	10%	=	0.0069
	60%	=	0.0479
Uniformity Coeff. (60%/10%)		=	6.98



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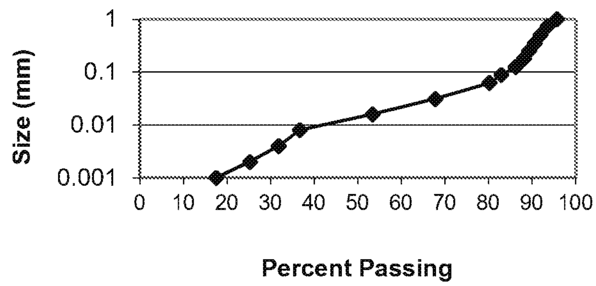
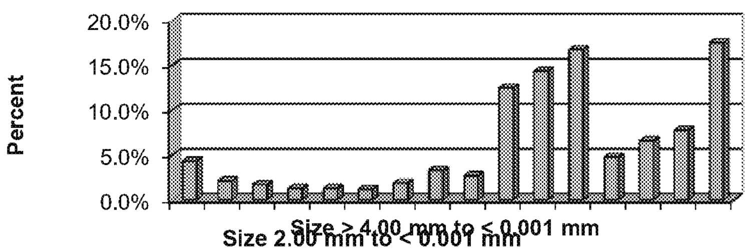
Particle Size Distribution

LABORATORY #: 7040309-4/32
IDENTIFICATION: VS3-2
DATE RECEIVED: April 10, 2017

*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	4.3%	4.3%
1 to 0.75		2.1%	6.5%
0.75-0.50		1.7%	8.2%
0.50-0.35		1.3%	9.4%
0.35-0.25		1.3%	10.7%
0.25-0.18		1.2%	11.9%
0.18-0.125		1.9%	13.8%
0.125-0.088		3.3%	17.1%
0.088-0.062		2.7%	19.8%
0.062-0.031	Silt	12.5%	32.3%
0.031-0.016		14.4%	46.6%
0.016-0.008		16.7%	63.4%
0.008-0.004		4.8%	68.1%
0.004-0.002		6.6%	74.7%
0.002-0.001	Clay	7.8%	82.5%
< 0.001		17.5%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		12.6%	-



Very Coarse Sand %	4.3%		
Coarse Sand %	3.8%		
Medium Sand %	2.6%		
Fine Sand %	6.4%		
Very Fine Sand %	2.7%		
Classification:	**Silty Loam**		
Sand	19.8%		
Silt	54.9%		
Clay	25.3%		
Effective Size (mm):	10%	=	#VALUE!
	60%	=	0.0229
Uniformity Coeff. (60%/10%)		=	#VALUE!



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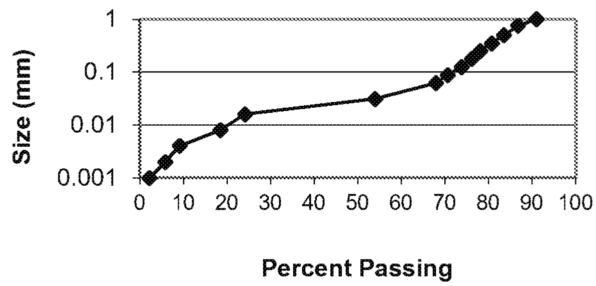
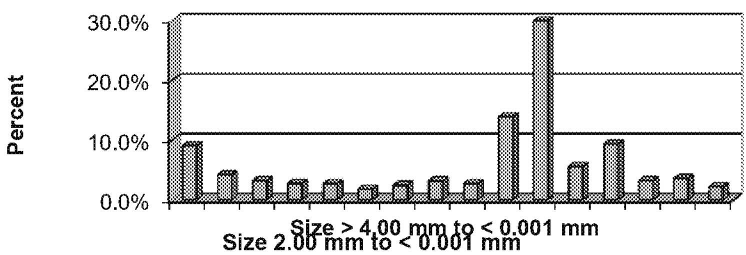
Particle Size Distribution

LABORATORY #: 7040309-5/32
IDENTIFICATION: VS4-1
DATE RECEIVED: April 10, 2017



*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	9.0%	9.0%
1 to 0.75		4.2%	13.3%
0.75-0.50		3.2%	16.5%
0.50-0.35		2.8%	19.3%
0.35-0.25		2.7%	22.0%
0.25-0.18		1.8%	23.8%
0.18-0.125		2.4%	26.2%
0.125-0.088		3.2%	29.4%
0.088-0.062		2.7%	32.1%
0.062-0.031	Silt	13.9%	46.0%
0.031-0.016		29.9%	75.9%
0.016-0.008		5.6%	81.5%
0.008-0.004		9.3%	90.9%
0.004-0.002		3.3%	94.2%
0.002-0.001	Clay	3.6%	97.8%
< 0.001		2.2%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		32.1%	-

Very Coarse Sand %	9.0%		
Coarse Sand %	7.4%		
Medium Sand %	5.5%		
Fine Sand %	7.4%		
Very Fine Sand %	2.7%		
Classification:	**Silty Loam**		
Sand	32.1%		
Silt	62.0%		
Clay	5.8%		
Effective Size (mm):	10%	=	0.0044
	60%	=	0.0444
Uniformity Coeff. (60%/10%)		=	10.14



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May 5, 2017

Particle Size Distribution

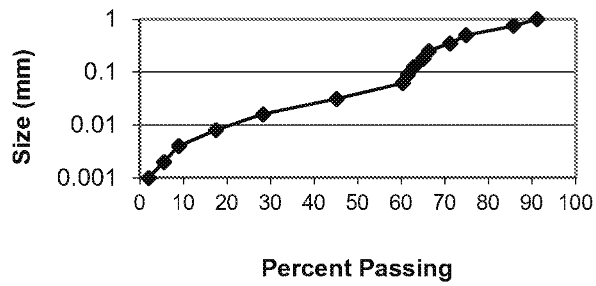
LABORATORY #: 7040309-6/32
IDENTIFICATION: VS5-1
DATE RECEIVED: April 10, 2017

*Gravel and stones are removed first

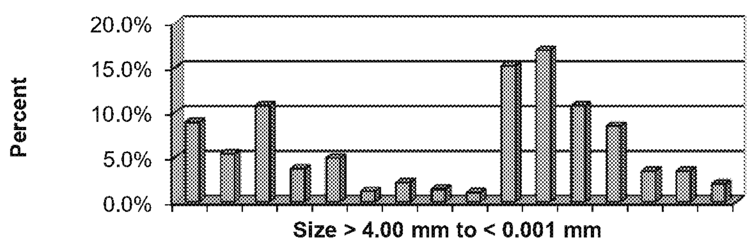
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	8.9%	8.9%
1 to 0.75		5.4%	14.3%
0.75-0.50		10.8%	25.1%
0.50-0.35		3.7%	28.8%
0.35-0.25		4.9%	33.7%
0.25-0.18		1.2%	34.9%
0.18-0.125		2.2%	37.1%
0.125-0.088		1.5%	38.6%
0.088-0.062		1.1%	39.7%
0.062-0.031	Silt	15.2%	54.9%
0.031-0.016		16.9%	71.8%
0.016-0.008		10.8%	82.6%
0.008-0.004		8.5%	91.0%
0.004-0.002		3.5%	94.5%
0.002-0.001	Clay	3.5%	98.0%
< 0.001		2.0%	100.0%

*Gravel % based on whole sample (nothing removed)

Gravel		27.9%	-



Very Coarse Sand %	8.9%		
Coarse Sand %	16.2%		
Medium Sand %	8.6%		
Fine Sand %	4.9%		
Very Fine Sand %	1.1%		
Classification:	**Silty Loam**		
Sand	39.7%		
Silt	54.9%		
Clay	5.5%		
Effective Size (mm):	10%	=	0.0045
	60%	=	0.0613
Uniformity Coeff. (60%/10%)		=	13.64



Size 2.00 mm to < 0.001 mm

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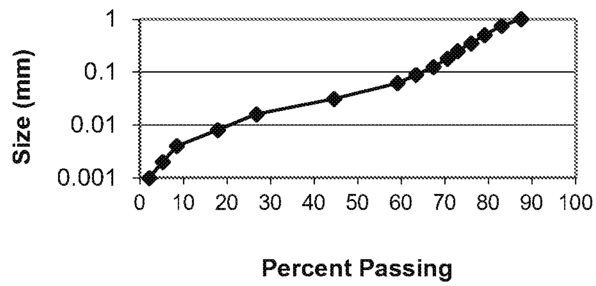
May 5, 2017

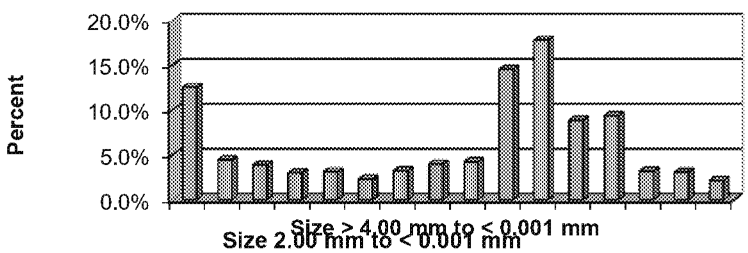
Particle Size Distribution

LABORATORY #: 7040309-7/32
IDENTIFICATION: VS6-1
DATE RECEIVED: April 10, 2017

*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	12.6%	12.6%
1 to 0.75		4.5%	17.0%
0.75-0.50		3.9%	20.9%
0.50-0.35		3.0%	23.9%
0.35-0.25		3.1%	27.1%
0.25-0.18		2.3%	29.4%
0.18-0.125		3.3%	32.7%
0.125-0.088		4.0%	36.7%
0.088-0.062		4.2%	40.9%
0.062-0.031	Silt	14.5%	55.5%
0.031-0.016		17.8%	73.2%
0.016-0.008		8.9%	82.1%
0.008-0.004		9.4%	91.5%
0.004-0.002		3.2%	94.7%
0.002-0.001	Clay	3.1%	97.8%
< 0.001		2.2%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		47.2%	-



Very Coarse Sand %	12.6%		
Coarse Sand %	8.4%		
Medium Sand %	6.2%		
Fine Sand %	9.6%		
Very Fine Sand %	4.2%		
Classification:	**Silty Loam**		
Sand	40.9%		
Silt	53.8%		
Clay	5.3%		
Effective Size (mm):	10%	=	0.0047
	60%	=	0.0676
Uniformity Coeff. (60%/10%)		=	14.51



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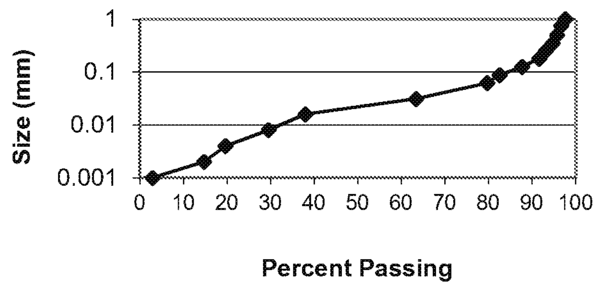
May 5, 2017

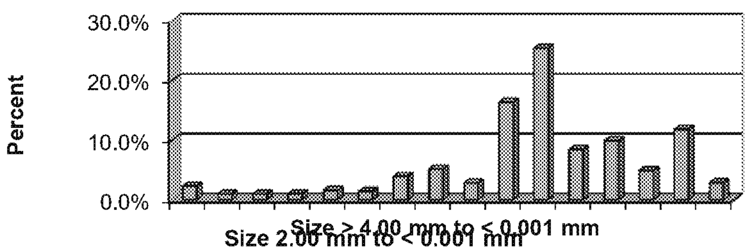
Particle Size Distribution

LABORATORY #: 7040309-8/32
IDENTIFICATION: VS6-2
DATE RECEIVED: April 10, 2017

*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	2.3%	2.3%
1 to 0.75		1.0%	3.3%
0.75-0.50		1.0%	4.3%
0.50-0.35		1.0%	5.3%
0.35-0.25		1.6%	6.9%
0.25-0.18		1.4%	8.4%
0.18-0.125		4.0%	12.3%
0.125-0.088		5.2%	17.5%
0.088-0.062		2.9%	20.4%
0.062-0.031	Silt	16.3%	36.7%
0.031-0.016		25.4%	62.0%
0.016-0.008		8.5%	70.5%
0.008-0.004		9.9%	80.4%
0.004-0.002		4.9%	85.3%
0.002-0.001	Clay	11.8%	97.1%
< 0.001		2.9%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		6.3%	-



Very Coarse Sand %	2.3%		
Coarse Sand %	2.0%		
Medium Sand %	2.6%		
Fine Sand %	10.6%		
Very Fine Sand %	2.9%		
Classification:	**Silty Loam**		
Sand	20.4%		
Silt	64.9%		
Clay	14.7%		
Effective Size (mm):	10%	=	0.0016
	60%	=	0.0290
Uniformity Coeff. (60%/10%)		=	18.13



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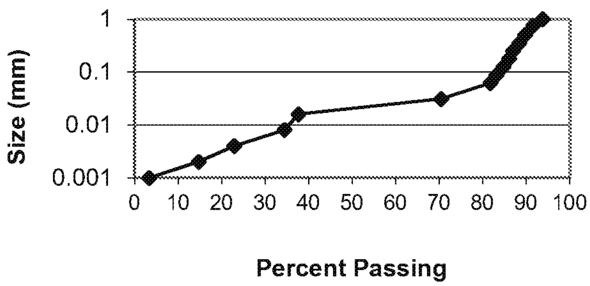
May 5, 2017

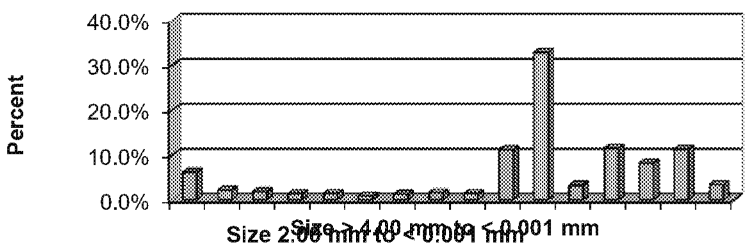
Particle Size Distribution

LABORATORY #: 7040309-9/32
IDENTIFICATION: VS6-3
DATE RECEIVED: April 10, 2017

*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	6.2%	6.2%
1 to 0.75		2.2%	8.4%
0.75-0.50		1.9%	10.3%
0.50-0.35		1.4%	11.7%
0.35-0.25		1.4%	13.1%
0.25-0.18		0.8%	13.9%
0.18-0.125		1.3%	15.2%
0.125-0.088		1.6%	16.9%
0.088-0.062		1.4%	18.3%
0.062-0.031	Silt	11.2%	29.5%
0.031-0.016		32.8%	62.3%
0.016-0.008		3.3%	65.6%
0.008-0.004		11.5%	77.1%
0.004-0.002		8.2%	85.3%
0.002-0.001	Clay	11.3%	96.6%
< 0.001		3.4%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		21.2%	-



Very Coarse Sand %	6.2%		
Coarse Sand %	4.1%		
Medium Sand %	2.8%		
Fine Sand %	3.8%		
Very Fine Sand %	1.4%		
Classification:	**Silty Loam**		
Sand	18.3%		
Silt	67.0%		
Clay	14.7%		
Effective Size (mm):	10%	=	0.0016
	60%	=	0.0262
Uniformity Coeff. (60%/10%)		=	16.52



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7040309-32-9690

Dudek
605 3rd Street
Encinitas, CA 92024
Andy Thomson

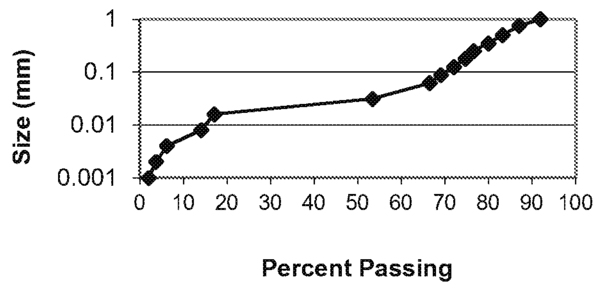
May 5, 2017

Particle Size Distribution

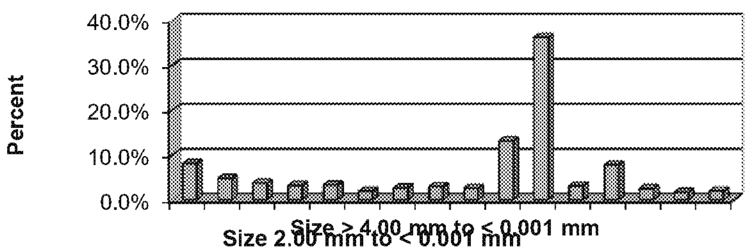
LABORATORY #: 7040309-10/32
IDENTIFICATION: VS6-4
DATE RECEIVED: April 10, 2017

*Gravel and stones are removed first

SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	8.2%	8.2%
1 to 0.75		4.8%	13.0%
0.75-0.50		3.8%	16.8%
0.50-0.35		3.2%	20.0%
0.35-0.25		3.3%	23.3%
0.25-0.18		2.0%	25.3%
0.18-0.125		2.7%	28.0%
0.125-0.088		3.0%	30.9%
0.088-0.062		2.6%	33.5%
0.062-0.031	Silt	13.1%	46.7%
0.031-0.016		36.2%	82.9%
0.016-0.008		3.1%	86.0%
0.008-0.004		7.8%	93.8%
0.004-0.002		2.5%	96.3%
0.002-0.001	Clay	1.7%	98.0%
< 0.001		2.0%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		22.3%	-



Very Coarse Sand %	8.2%		
Coarse Sand %	8.6%		
Medium Sand %	6.6%		
Fine Sand %	7.6%		
Very Fine Sand %	2.6%		
Classification:	**Silty Loam**		
Sand	33.5%		
Silt	62.8%		
Clay	3.7%		
Effective Size (mm):	10%	=	0.0059
	60%	=	0.0467
Uniformity Coeff. (60%/10%)		=	7.86



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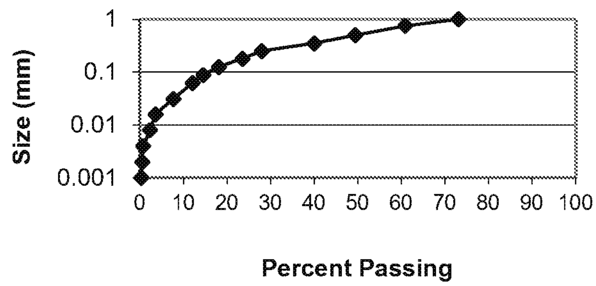
May 5, 2017

Particle Size Distribution

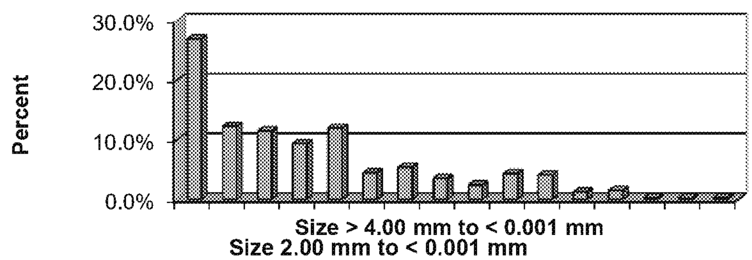
LABORATORY #: 7040309-11/32
IDENTIFICATION: EL2-1
DATE RECEIVED: April 10, 2017

*Gravel and stones are removed first

SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	26.9%	26.9%
1 to 0.75		12.2%	39.1%
0.75-0.50		11.5%	50.6%
0.50-0.35		9.4%	60.0%
0.35-0.25		12.0%	72.0%
0.25-0.18		4.5%	76.5%
0.18-0.125		5.4%	81.9%
0.125-0.088		3.6%	85.5%
0.088-0.062		2.5%	87.9%
0.062-0.031	Silt	4.3%	92.3%
0.031-0.016		4.1%	96.4%
0.016-0.008		1.3%	97.7%
0.008-0.004		1.5%	99.2%
0.004-0.002		0.3%	99.5%
0.002-0.001	Clay	0.2%	99.7%
< 0.001		0.3%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		36.3%	-



Very Coarse Sand %	26.9%		
Coarse Sand %	23.7%		
Medium Sand %	21.4%		
Fine Sand %	13.5%		
Very Fine Sand %	2.5%		
Classification:	**Loamy Sand**		
Sand	87.9%		
Silt	11.5%		
Clay	0.5%		
Effective Size (mm):	10%	=	0.0474
	60%	=	0.7312
Uniformity Coeff. (60%/10%)		=	15.44



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May 5, 2017

Particle Size Distribution

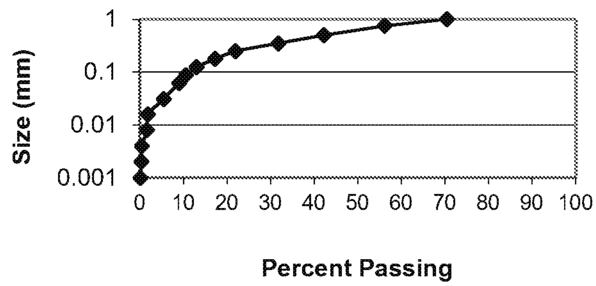
LABORATORY #: 7040309-12/32
IDENTIFICATION: EL4-1
DATE RECEIVED: April 10, 2017

*Gravel and stones are removed first

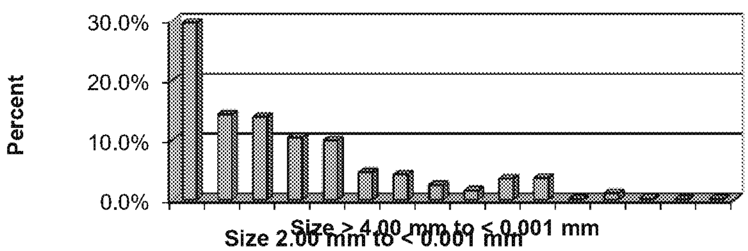
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	29.6%	29.6%
1 to 0.75		14.3%	43.9%
0.75-0.50		13.9%	57.7%
0.50-0.35		10.4%	68.2%
0.35-0.25		9.9%	78.1%
0.25-0.18		4.6%	82.7%
0.18-0.125		4.2%	87.0%
0.125-0.088		2.5%	89.5%
0.088-0.062		1.6%	91.0%
0.062-0.031	Silt	3.6%	94.6%
0.031-0.016		3.7%	98.3%
0.016-0.008		0.2%	98.4%
0.008-0.004		1.1%	99.5%
0.004-0.002		0.2%	99.7%
0.002-0.001	Clay	0.1%	99.8%
< 0.001		0.2%	100.0%

*Gravel % based on whole sample (nothing removed)

Gravel		26.8%	-



Very Coarse Sand %	29.6%		
Coarse Sand %	28.1%		
Medium Sand %	20.3%		
Fine Sand %	11.4%		
Very Fine Sand %	1.6%		
Classification:	**Sand**		
Sand	91.0%		
Silt	8.7%		
Clay	0.3%		
Effective Size (mm):	10%	=	0.0789
	60%	=	0.8181
Uniformity Coeff. (60%/10%)		=	10.38



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May 5, 2017

Particle Size Distribution

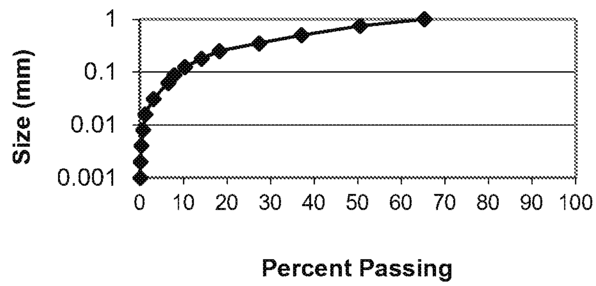
LABORATORY #: 7040309-13/32
IDENTIFICATION: EL5-1
DATE RECEIVED: April 10, 2017

*Gravel and stones are removed first

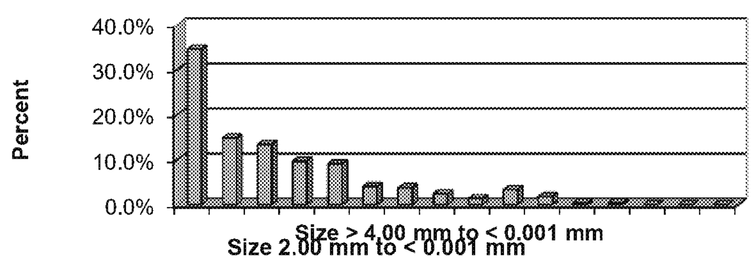
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	34.6%	34.6%
1 to 0.75		14.9%	49.5%
0.75-0.50		13.5%	63.0%
0.50-0.35		9.7%	72.7%
0.35-0.25		9.1%	81.8%
0.25-0.18		4.1%	85.8%
0.18-0.125		3.8%	89.7%
0.125-0.088		2.5%	92.1%
0.088-0.062		1.4%	93.6%
0.062-0.031	Silt	3.4%	96.9%
0.031-0.016		1.9%	98.8%
0.016-0.008		0.5%	99.2%
0.008-0.004		0.5%	99.7%
0.004-0.002		0.1%	99.8%
0.002-0.001	Clay	0.1%	99.9%
< 0.001		0.1%	100.0%

*Gravel % based on whole sample (nothing removed)

Gravel		38.5%	-



Very Coarse Sand %	34.6%		
Coarse Sand %	28.3%		
Medium Sand %	18.8%		
Fine Sand %	10.4%		
Very Fine Sand %	1.4%		
Classification:	**Sand**		
Sand	93.6%		
Silt	6.3%		
Clay	0.2%		
Effective Size (mm):	10%	=	0.1201
	60%	=	0.9098
Uniformity Coeff. (60%/10%)		=	7.57



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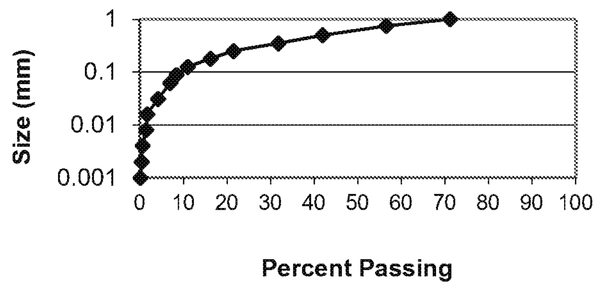
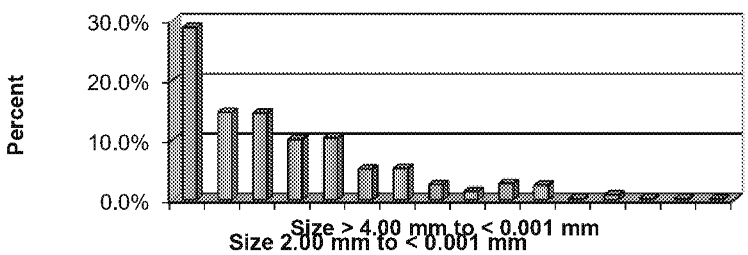
Particle Size Distribution

LABORATORY #: 7040309-14/32
IDENTIFICATION: EL6-1
DATE RECEIVED: April 10, 2017

*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	28.8%	28.8%
1 to 0.75		14.6%	43.5%
0.75-0.50		14.5%	58.0%
0.50-0.35		10.1%	68.2%
0.35-0.25		10.4%	78.5%
0.25-0.18		5.2%	83.7%
0.18-0.125		5.3%	89.1%
0.125-0.088		2.6%	91.6%
0.088-0.062		1.4%	93.1%
0.062-0.031	Silt	2.8%	95.8%
0.031-0.016		2.5%	98.3%
0.016-0.008		0.2%	98.6%
0.008-0.004		0.9%	99.4%
0.004-0.002		0.2%	99.7%
0.002-0.001	Clay	0.2%	99.9%
< 0.001		0.1%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		27.7%	-



Very Coarse Sand %	28.8%		
Coarse Sand %	29.2%		
Medium Sand %	20.5%		
Fine Sand %	13.1%		
Very Fine Sand %	1.4%		
Classification:	**Sand**		
Sand	93.1%		
Silt	6.6%		
Clay	0.3%		
Effective Size (mm):	10%	=	0.1115
	60%	=	0.8094
Uniformity Coeff. (60%/10%)		=	7.26



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May 5, 2017

Particle Size Distribution

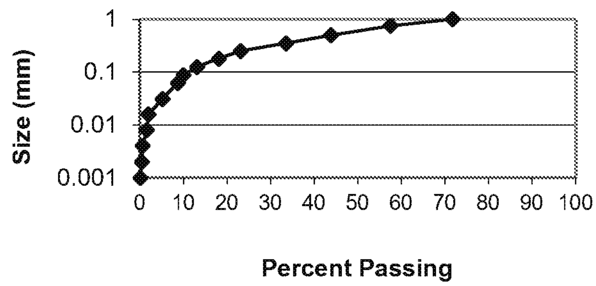
LABORATORY #: 7040309-15/32
IDENTIFICATION: EL7-1
DATE RECEIVED: April 10, 2017

*Gravel and stones are removed first

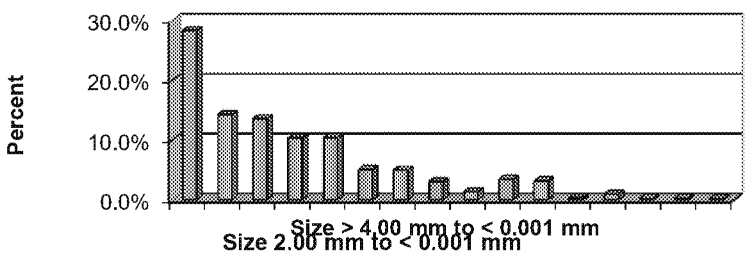
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	28.3%	28.3%
1 to 0.75		14.3%	42.5%
0.75-0.50		13.6%	56.1%
0.50-0.35		10.3%	66.4%
0.35-0.25		10.4%	76.9%
0.25-0.18		5.1%	81.9%
0.18-0.125		5.0%	86.9%
0.125-0.088		3.1%	90.0%
0.088-0.062		1.4%	91.4%
0.062-0.031	Silt	3.4%	94.8%
0.031-0.016		3.2%	98.0%
0.016-0.008		0.4%	98.4%
0.008-0.004		1.0%	99.4%
0.004-0.002		0.2%	99.6%
0.002-0.001	Clay	0.2%	99.8%
< 0.001		0.2%	100.0%

*Gravel % based on whole sample (nothing removed)

Gravel		28.0%	-



Very Coarse Sand %	28.3%		
Coarse Sand %	27.8%		
Medium Sand %	20.7%		
Fine Sand %	13.1%		
Very Fine Sand %	1.4%		
Classification:	**Sand**		
Sand	91.4%		
Silt	8.2%		
Clay	0.4%		
Effective Size (mm):	10%	=	0.0878
	60%	=	0.7945
Uniformity Coeff. (60%/10%)		=	9.05



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May 5, 2017

Particle Size Distribution

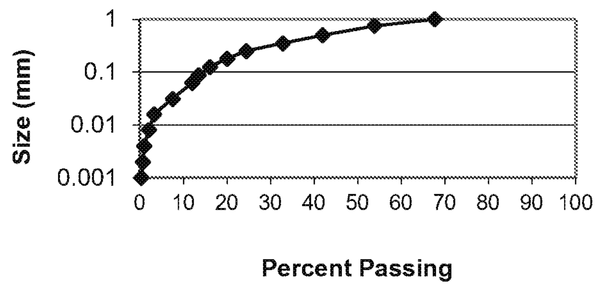
LABORATORY #: 7040309-16/32
IDENTIFICATION: EL8-1
DATE RECEIVED: April 10, 2017

*Gravel and stones are removed first

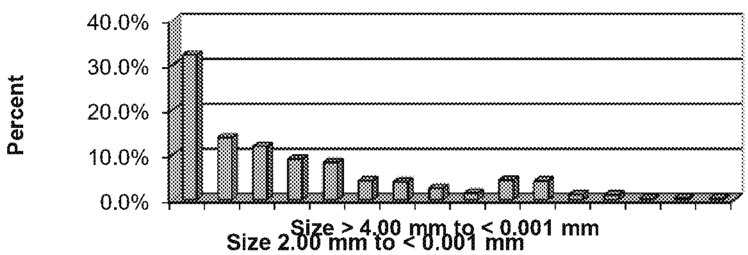
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	32.3%	32.3%
1 to 0.75		13.9%	46.2%
0.75-0.50		11.9%	58.1%
0.50-0.35		9.1%	67.2%
0.35-0.25		8.3%	75.6%
0.25-0.18		4.3%	79.9%
0.18-0.125		4.0%	83.9%
0.125-0.088		2.6%	86.5%
0.088-0.062		1.5%	88.1%
0.062-0.031	Silt	4.5%	92.5%
0.031-0.016		4.2%	96.7%
0.016-0.008		1.2%	97.9%
0.008-0.004		1.1%	99.1%
0.004-0.002		0.2%	99.3%
0.002-0.001	Clay	0.4%	99.7%
< 0.001		0.3%	100.0%

*Gravel % based on whole sample (nothing removed)

Gravel		35.8%	-



Very Coarse Sand %	32.3%		
Coarse Sand %	25.8%		
Medium Sand %	17.5%		
Fine Sand %	10.9%		
Very Fine Sand %	1.5%		
Classification:	**Loamy Sand**		
Sand	88.1%		
Silt	11.3%		
Clay	0.7%		
Effective Size (mm):	10%	=	0.0484
	60%	=	0.8616
Uniformity Coeff. (60%/10%)		=	17.79



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Particle Size Distribution

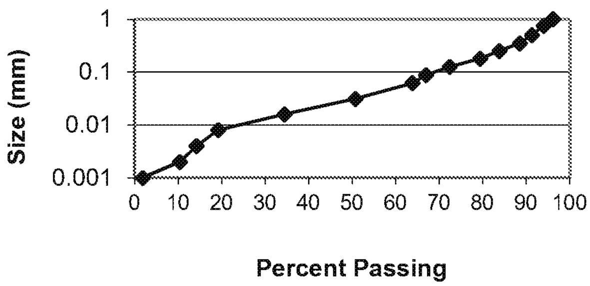
LABORATORY #: 7040309-17/32
IDENTIFICATION: EL9-1
DATE RECEIVED: April 10, 2017

*Gravel and stones are removed first

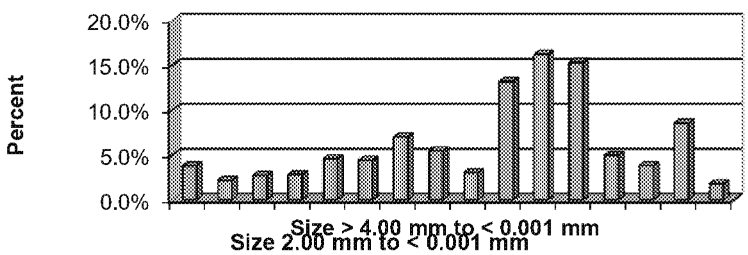
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	3.8%	3.8%
1 to 0.75		2.2%	6.0%
0.75-0.50		2.7%	8.7%
0.50-0.35		2.8%	11.5%
0.35-0.25		4.6%	16.1%
0.25-0.18		4.4%	20.6%
0.18-0.125		7.0%	27.6%
0.125-0.088		5.5%	33.1%
0.088-0.062		3.0%	36.1%
0.062-0.031	Silt	13.2%	49.3%
0.031-0.016		16.2%	65.5%
0.016-0.008		15.3%	80.8%
0.008-0.004		5.0%	85.8%
0.004-0.002		3.8%	89.6%
0.002-0.001	Clay	8.6%	98.2%
< 0.001		1.8%	100.0%

*Gravel % based on whole sample (nothing removed)

Gravel		4.6%	-



Very Coarse Sand %	3.8%		
Coarse Sand %	4.9%		
Medium Sand %	7.4%		
Fine Sand %	16.9%		
Very Fine Sand %	3.0%		
Classification:	**Silty Loam**		
Sand	36.1%		
Silt	53.5%		
Clay	10.4%		
Effective Size (mm):	10%	=	0.0020
	60%	=	0.0529
Uniformity Coeff. (60%/10%)		=	27.01



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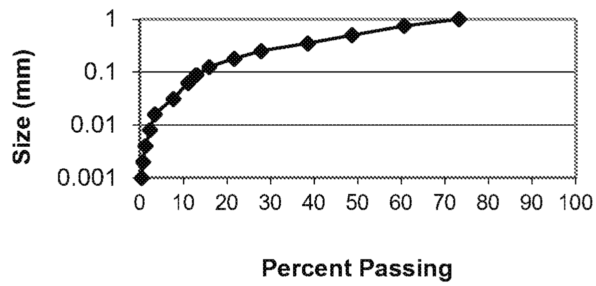
Particle Size Distribution

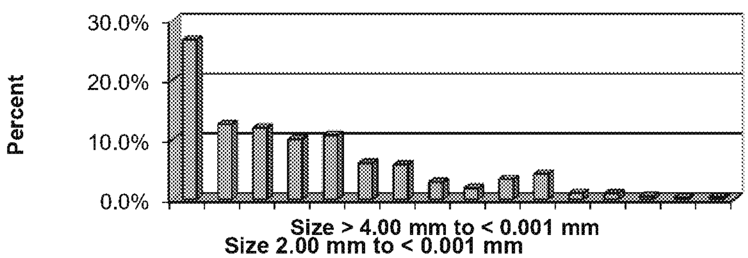
LABORATORY #: 7040309-18/32
IDENTIFICATION: EL10-1
DATE RECEIVED: April 10, 2017

*Gravel and stones are removed first

SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	26.7%	26.7%
1 to 0.75		12.6%	39.3%
0.75-0.50		12.0%	51.3%
0.50-0.35		10.1%	61.4%
0.35-0.25		10.8%	72.2%
0.25-0.18		6.1%	78.3%
0.18-0.125		5.8%	84.2%
0.125-0.088		2.9%	87.1%
0.088-0.062		1.9%	89.0%
0.062-0.031	Silt	3.4%	92.4%
0.031-0.016		4.3%	96.6%
0.016-0.008		1.1%	97.7%
0.008-0.004		1.0%	98.7%
0.004-0.002		0.5%	99.3%
0.002-0.001	Clay	0.3%	99.6%
< 0.001		0.4%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		20.0%	-



Very Coarse Sand %	26.7%		
Coarse Sand %	24.6%		
Medium Sand %	20.9%		
Fine Sand %	14.9%		
Very Fine Sand %	1.9%		
Classification:	**Loamy Sand**		
Sand	89.0%		
Silt	10.3%		
Clay	0.7%		
Effective Size (mm):	10%	=	0.0526
	60%	=	0.7361
Uniformity Coeff. (60%/10%)		=	13.99



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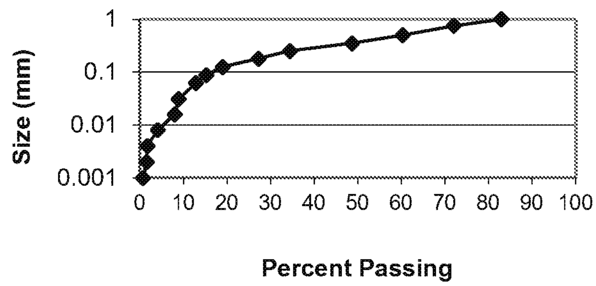
Andy Thomson

May 5, 2017

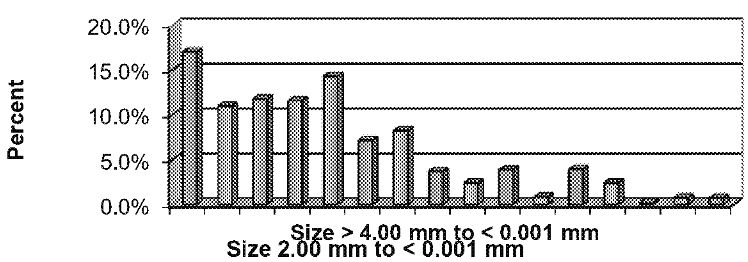
Particle Size Distribution

LABORATORY #: 7040309-19/32
IDENTIFICATION: EL11-1
DATE RECEIVED: April 10, 2017

*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	17.0%	17.0%
1 to 0.75		11.0%	28.0%
0.75-0.50		11.8%	39.8%
0.50-0.35		11.6%	51.4%
0.35-0.25		14.3%	65.6%
0.25-0.18		7.2%	72.8%
0.18-0.125		8.2%	81.0%
0.125-0.088		3.7%	84.8%
0.088-0.062		2.4%	87.2%
0.062-0.031	Silt	3.9%	91.1%
0.031-0.016		0.9%	92.0%
0.016-0.008		4.0%	95.9%
0.008-0.004		2.4%	98.3%
0.004-0.002		0.2%	98.5%
0.002-0.001	Clay	0.8%	99.3%
< 0.001		0.7%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		12.7%	-



Very Coarse Sand %	17.0%		
Coarse Sand %	22.8%		
Medium Sand %	25.9%		
Fine Sand %	19.1%		
Very Fine Sand %	2.4%		
Classification:	**Loamy Sand**		
Sand	87.2%		
Silt	11.3%		
Clay	1.5%		
Effective Size (mm):	10%	=	0.0396
	60%	=	0.4970
Uniformity Coeff. (60%/10%)		=	12.55



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Particle Size Distribution

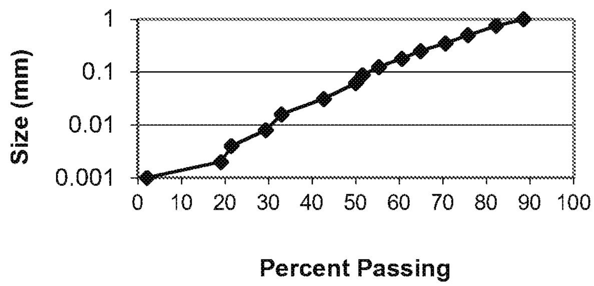
LABORATORY #: 7040309-20/32
IDENTIFICATION: CM1-1
DATE RECEIVED: April 10, 2017

*Gravel and stones are removed first

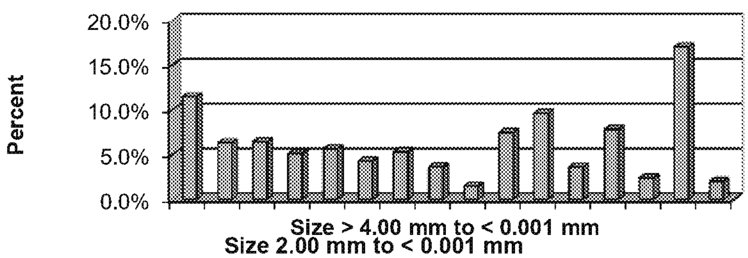
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	11.5%	11.5%
1 to 0.75		6.3%	17.8%
0.75-0.50		6.5%	24.3%
0.50-0.35		5.2%	29.4%
0.35-0.25		5.7%	35.1%
0.25-0.18		4.3%	39.4%
0.18-0.125		5.3%	44.8%
0.125-0.088		3.7%	48.4%
0.088-0.062		1.5%	49.9%
0.062-0.031	Silt	7.5%	57.4%
0.031-0.016		9.6%	67.1%
0.016-0.008		3.6%	70.7%
0.008-0.004		7.8%	78.5%
0.004-0.002		2.4%	80.9%
0.002-0.001	Clay	17.0%	98.0%
< 0.001		2.0%	100.0%

*Gravel % based on whole sample (nothing removed)

Gravel		16.3%	-



Very Coarse Sand %	11.5%		
Coarse Sand %	12.8%		
Medium Sand %	10.8%		
Fine Sand %	13.3%		
Very Fine Sand %	1.5%		
Classification:	**Loam**		
Sand	49.9%		
Silt	31.0%		
Clay	19.1%		
Effective Size (mm):	10%	=	0.0015
	60%	=	0.1741
Uniformity Coeff. (60%/10%)		=	118.65



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Particle Size Distribution

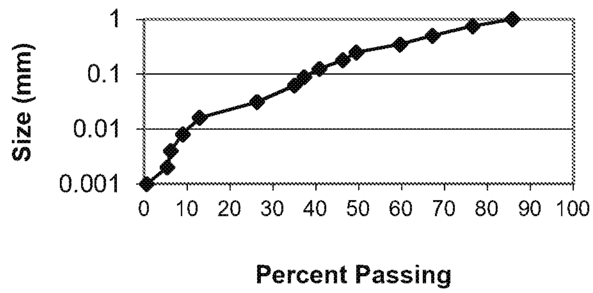
LABORATORY #: 7040309-21/32
IDENTIFICATION: CM2-1
DATE RECEIVED: April 10, 2017

*Gravel and stones are removed first

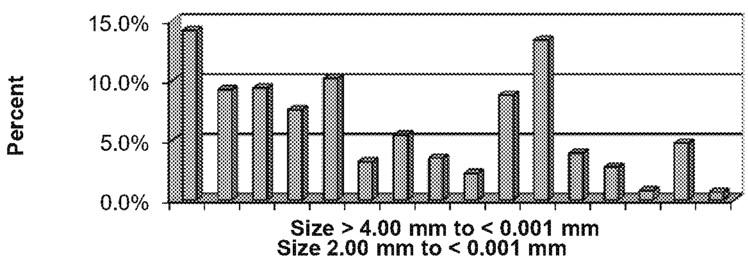
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	14.2%	14.2%
1 to 0.75		9.2%	23.4%
0.75-0.50		9.4%	32.8%
0.50-0.35		7.5%	40.3%
0.35-0.25		10.2%	50.5%
0.25-0.18		3.2%	53.7%
0.18-0.125		5.5%	59.2%
0.125-0.088		3.5%	62.7%
0.088-0.062		2.2%	64.9%
0.062-0.031	Silt	8.8%	73.7%
0.031-0.016		13.4%	87.1%
0.016-0.008		3.9%	91.0%
0.008-0.004		2.8%	93.8%
0.004-0.002		0.8%	94.5%
0.002-0.001	Clay	4.8%	99.3%
< 0.001		0.7%	100.0%

*Gravel % based on whole sample (nothing removed)

Gravel		13.1%	-



Very Coarse Sand %	14.2%		
Coarse Sand %	18.6%		
Medium Sand %	17.7%		
Fine Sand %	12.2%		
Very Fine Sand %	2.2%		
Classification:	**Sandy Loam**		
Sand	64.9%		
Silt	29.6%		
Clay	5.5%		
Effective Size (mm):	10%	=	0.0100
	60%	=	0.3565
Uniformity Coeff. (60%/10%)		=	35.50



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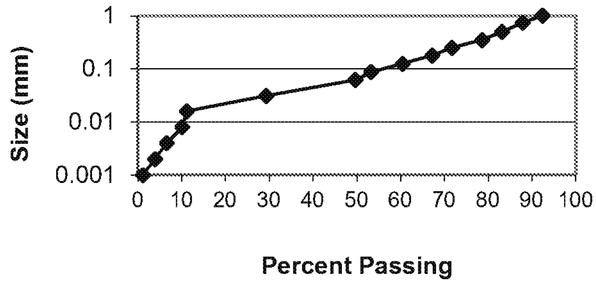
Particle Size Distribution

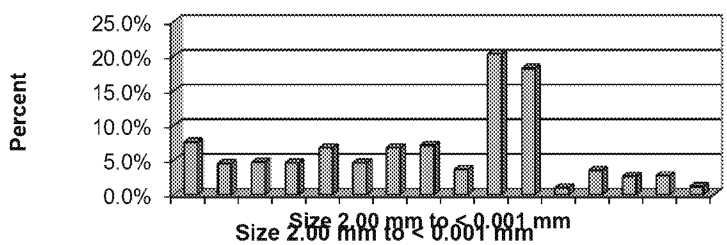
LABORATORY #: 7040309-22/32
IDENTIFICATION: CM2-2
DATE RECEIVED: April 10, 2017



*Gravel and stones are removed first

SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	7.6%	7.6%
1 to 0.75		4.5%	12.1%
0.75-0.50		4.7%	16.8%
0.50-0.35		4.6%	21.4%
0.35-0.25		6.8%	28.2%
0.25-0.18		4.6%	32.8%
0.18-0.125		6.8%	39.6%
0.125-0.088		7.1%	46.7%
0.088-0.062		3.6%	50.3%
0.062-0.031	Silt	20.3%	70.6%
0.031-0.016		18.2%	88.8%
0.016-0.008		1.0%	89.8%
0.008-0.004		3.5%	93.4%
0.004-0.002		2.7%	96.0%
0.002-0.001	Clay	2.8%	98.8%
< 0.001		1.2%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		9.9%	-

Very Coarse Sand %	7.6%		
Coarse Sand %	9.2%		
Medium Sand %	11.4%		
Fine Sand %	18.5%		
Very Fine Sand %	3.6%		
Classification:	**Sandy Loam**		
Sand	50.3%		
Silt	45.7%		
Clay	4.0%		
Effective Size (mm):	10%	=	0.0078
	60%	=	0.1228
Uniformity Coeff. (60%/10%)		=	15.70



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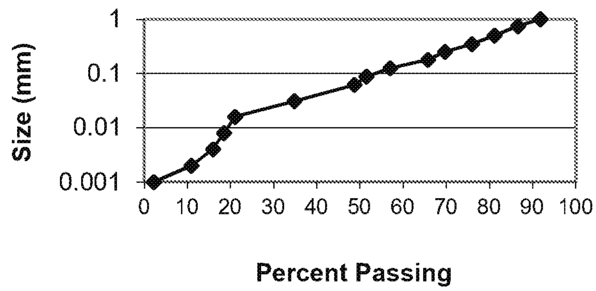
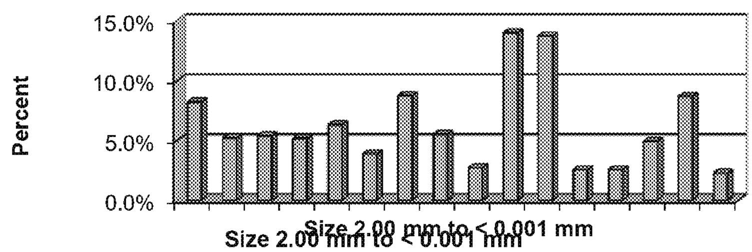
Particle Size Distribution

LABORATORY #: 7040309-23/32
IDENTIFICATION: CM3-1
DATE RECEIVED: April 10, 2017

*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	8.2%	8.2%
1 to 0.75		5.2%	13.4%
0.75-0.50		5.4%	18.8%
0.50-0.35		5.2%	24.0%
0.35-0.25		6.3%	30.3%
0.25-0.18		3.9%	34.2%
0.18-0.125		8.7%	43.0%
0.125-0.088		5.5%	48.5%
0.088-0.062		2.7%	51.2%
0.062-0.031	Silt	14.0%	65.2%
0.031-0.016		13.7%	78.9%
0.016-0.008		2.6%	81.5%
0.008-0.004		2.6%	84.1%
0.004-0.002		4.9%	89.0%
0.002-0.001	Clay	8.7%	97.7%
< 0.001		2.3%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		10.8%	-



Very Coarse Sand %	8.2%		
Coarse Sand %	10.6%		
Medium Sand %	11.5%		
Fine Sand %	18.2%		
Very Fine Sand %	2.7%		
Classification:	**Loam**		
Sand	51.2%		
Silt	37.8%		
Clay	11.0%		
Effective Size (mm):	10%	=	0.0019
	60%	=	0.1436
Uniformity Coeff. (60%/10%)		=	76.15



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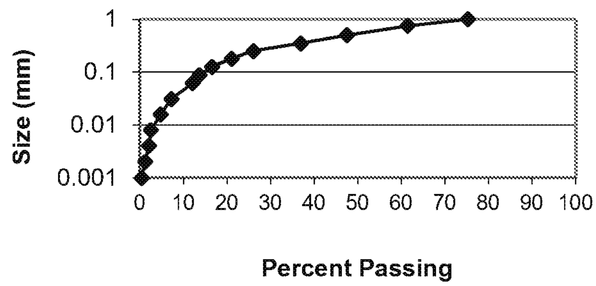
May 5, 2017

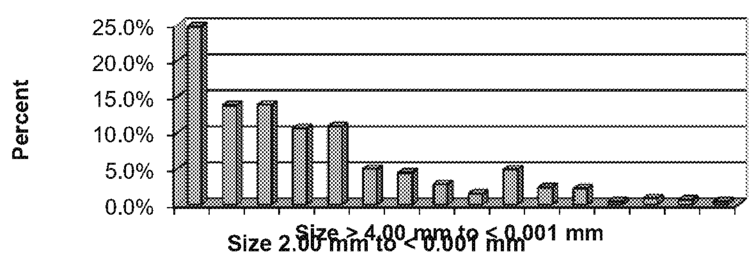
Particle Size Distribution

LABORATORY #: 7040309-24/32
IDENTIFICATION: CM5-1
DATE RECEIVED: April 10, 2017

*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	24.8%	24.8%
1 to 0.75		13.8%	38.6%
0.75-0.50		13.9%	52.5%
0.50-0.35		10.6%	63.1%
0.35-0.25		10.9%	74.0%
0.25-0.18		5.0%	79.0%
0.18-0.125		4.5%	83.5%
0.125-0.088		2.9%	86.3%
0.088-0.062		1.5%	87.9%
0.062-0.031	Silt	4.9%	92.8%
0.031-0.016		2.4%	95.2%
0.016-0.008		2.3%	97.5%
0.008-0.004		0.5%	97.9%
0.004-0.002		0.9%	98.8%
0.002-0.001	Clay	0.7%	99.5%
< 0.001		0.5%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		34.7%	-



Very Coarse Sand %	24.8%		
Coarse Sand %	27.7%		
Medium Sand %	21.5%		
Fine Sand %	12.3%		
Very Fine Sand %	1.5%		
Classification:	**Loamy Sand**		
Sand	87.9%		
Silt	11.0%		
Clay	1.2%		
Effective Size (mm):	10%	=	0.0485
	60%	=	0.7248
Uniformity Coeff. (60%/10%)		=	14.93



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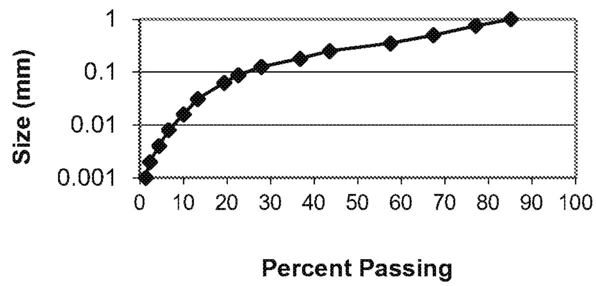
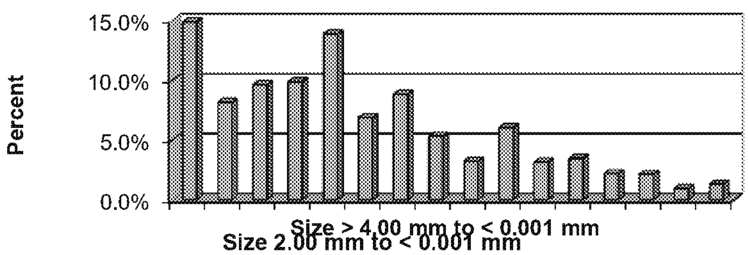
Particle Size Distribution

LABORATORY #: 7040309-25/32
IDENTIFICATION: CM6-1
DATE RECEIVED: April 10, 2017

*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	14.9%	14.9%
1 to 0.75		8.2%	23.0%
0.75-0.50		9.6%	32.7%
0.50-0.35		9.9%	42.5%
0.35-0.25		13.9%	56.4%
0.25-0.18		6.9%	63.3%
0.18-0.125		8.8%	72.1%
0.125-0.088		5.3%	77.5%
0.088-0.062		3.2%	80.7%
0.062-0.031	Silt	6.1%	86.7%
0.031-0.016		3.2%	89.9%
0.016-0.008		3.5%	93.4%
0.008-0.004		2.2%	95.6%
0.004-0.002		2.1%	97.7%
0.002-0.001	Clay	1.0%	98.7%
< 0.001		1.3%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		40.1%	-



Very Coarse Sand %	14.9%		
Coarse Sand %	17.8%		
Medium Sand %	23.8%		
Fine Sand %	21.0%		
Very Fine Sand %	3.2%		
Classification:	**Loamy Sand**		
Sand	80.7%		
Silt	17.1%		
Clay	2.3%		
Effective Size (mm):	10%	=	0.0158
	60%	=	0.3884
Uniformity Coeff. (60%/10%)		=	24.61



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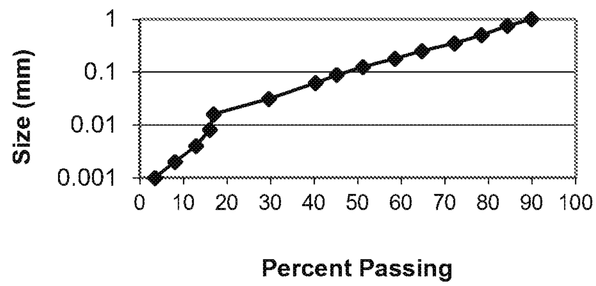
Particle Size Distribution

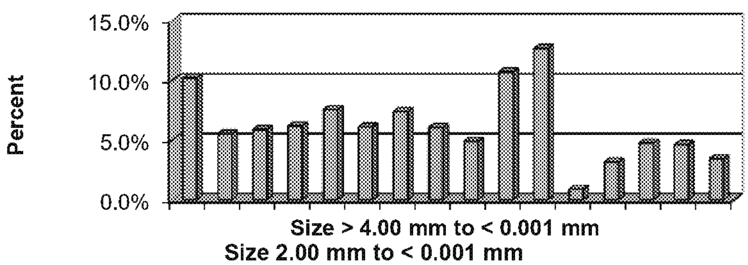
LABORATORY #: 7040309-26/32
IDENTIFICATION: CM7-1
DATE RECEIVED: April 10, 2017

*Gravel and stones are removed first

SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	10.2%	10.2%
1 to 0.75		5.5%	15.7%
0.75-0.50		5.9%	21.6%
0.50-0.35		6.2%	27.8%
0.35-0.25		7.5%	35.3%
0.25-0.18		6.1%	41.4%
0.18-0.125		7.4%	48.8%
0.125-0.088		6.1%	54.9%
0.088-0.062		4.9%	59.8%
0.062-0.031	Silt	10.7%	70.4%
0.031-0.016		12.7%	83.1%
0.016-0.008		0.9%	84.0%
0.008-0.004		3.2%	87.2%
0.004-0.002		4.7%	91.9%
0.002-0.001	Clay	4.6%	96.6%
< 0.001		3.4%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		23.5%	-



Very Coarse Sand %	10.2%		
Coarse Sand %	11.4%		
Medium Sand %	13.7%		
Fine Sand %	19.5%		
Very Fine Sand %	4.9%		
Classification:	**Sandy Loam**		
Sand	59.8%		
Silt	32.2%		
Clay	8.1%		
Effective Size (mm):	10%	=	0.0028
	60%	=	0.1962
Uniformity Coeff. (60%/10%)		=	69.88



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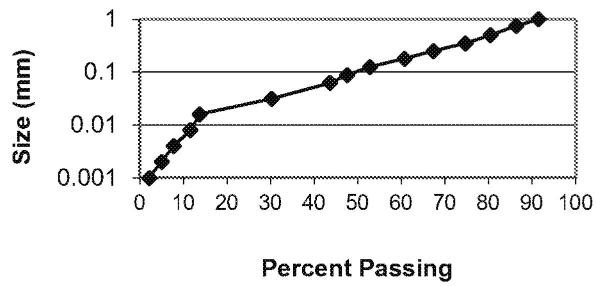
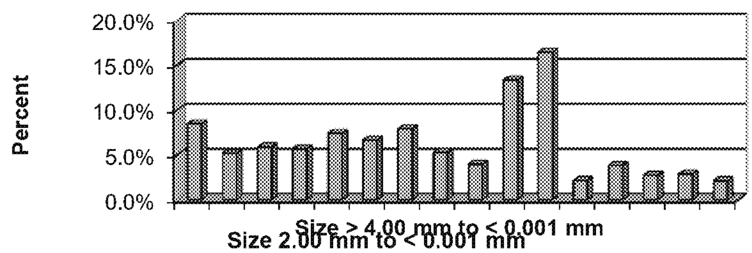
Particle Size Distribution

LABORATORY #: 7040309-27/32
IDENTIFICATION: CM7-2
DATE RECEIVED: April 10, 2017

*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	8.5%	8.5%
1 to 0.75		5.2%	13.7%
0.75-0.50		5.9%	19.6%
0.50-0.35		5.7%	25.2%
0.35-0.25		7.4%	32.6%
0.25-0.18		6.6%	39.3%
0.18-0.125		7.9%	47.2%
0.125-0.088		5.3%	52.5%
0.088-0.062		4.0%	56.5%
0.062-0.031	Silt	13.3%	69.8%
0.031-0.016		16.4%	86.2%
0.016-0.008		2.2%	88.4%
0.008-0.004		3.8%	92.3%
0.004-0.002		2.7%	95.0%
0.002-0.001	Clay	2.9%	97.9%
< 0.001		2.1%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		20.3%	-



Very Coarse Sand %	8.5%		
Coarse Sand %	11.1%		
Medium Sand %	13.1%		
Fine Sand %	19.8%		
Very Fine Sand %	4.0%		
Classification:	**Sandy Loam**		
Sand	56.5%		
Silt	38.5%		
Clay	5.0%		
Effective Size (mm):	10%	=	0.0064
	60%	=	0.1751
Uniformity Coeff. (60%/10%)		=	27.53



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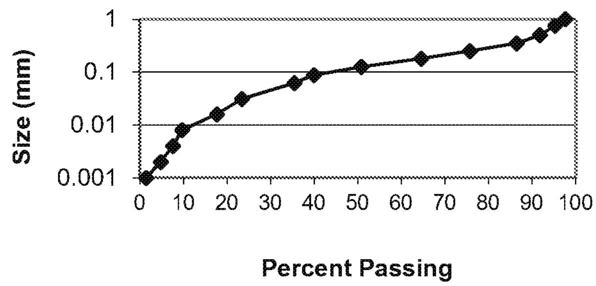
Andy Thomson

May 5, 2017

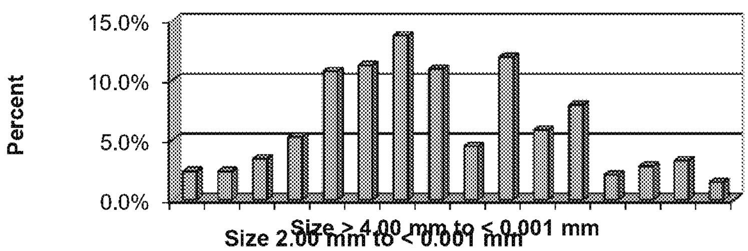
Particle Size Distribution

LABORATORY #: 7040309-28/32
IDENTIFICATION: CM8-1
DATE RECEIVED: April 10, 2017

*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	2.4%	2.4%
1 to 0.75		2.4%	4.8%
0.75-0.50		3.5%	8.2%
0.50-0.35		5.3%	13.5%
0.35-0.25		10.7%	24.2%
0.25-0.18		11.3%	35.5%
0.18-0.125		13.7%	49.2%
0.125-0.088		10.9%	60.1%
0.088-0.062		4.5%	64.6%
0.062-0.031	Silt	11.9%	76.5%
0.031-0.016		5.8%	82.4%
0.016-0.008		7.9%	90.3%
0.008-0.004		2.1%	92.4%
0.004-0.002		2.8%	95.2%
0.002-0.001	Clay	3.3%	98.5%
< 0.001		1.5%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		1.7%	-



Very Coarse Sand %	2.4%		
Coarse Sand %	5.8%		
Medium Sand %	16.0%		
Fine Sand %	35.9%		
Very Fine Sand %	4.5%		
Classification:	**Sandy Loam**		
Sand	64.6%		
Silt	30.6%		
Clay	4.8%		
Effective Size (mm):	10%	=	0.0083
	60%	=	0.1619
Uniformity Coeff. (60%/10%)		=	19.46



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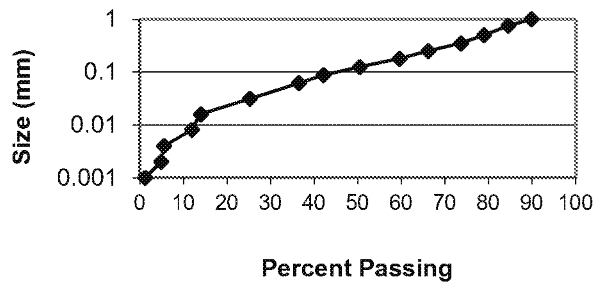
Andy Thomson

May 5, 2017

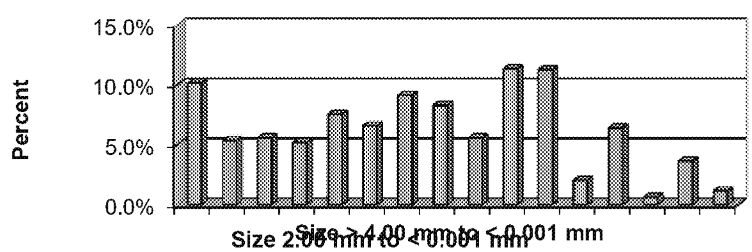
Particle Size Distribution

LABORATORY #: 7040309-29/32
IDENTIFICATION: CM8-2
DATE RECEIVED: April 10, 2017

*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	10.1%	10.1%
1 to 0.75		5.4%	15.5%
0.75-0.50		5.6%	21.1%
0.50-0.35		5.2%	26.3%
0.35-0.25		7.6%	33.8%
0.25-0.18		6.6%	40.4%
0.18-0.125		9.1%	49.6%
0.125-0.088		8.3%	57.9%
0.088-0.062		5.6%	63.4%
0.062-0.031	Silt	11.3%	74.8%
0.031-0.016		11.3%	86.1%
0.016-0.008		2.1%	88.1%
0.008-0.004		6.4%	94.5%
0.004-0.002		0.6%	95.2%
0.002-0.001	Clay	3.7%	98.8%
< 0.001		1.2%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		13.6%	-



Very Coarse Sand %	10.1%		
Coarse Sand %	11.0%		
Medium Sand %	12.8%		
Fine Sand %	24.0%		
Very Fine Sand %	5.6%		
Classification:	**Sandy Loam**		
Sand	63.4%		
Silt	31.7%		
Clay	4.8%		
Effective Size (mm):	10%	=	0.0068
	60%	=	0.1845
Uniformity Coeff. (60%/10%)		=	27.05



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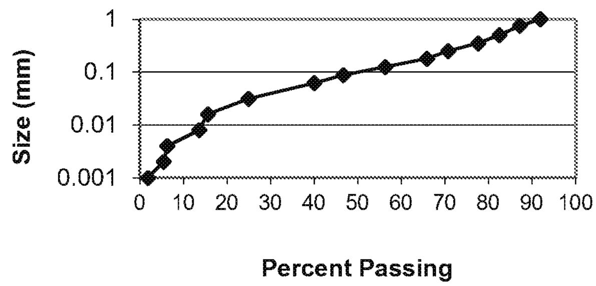
May 5, 2017

Particle Size Distribution

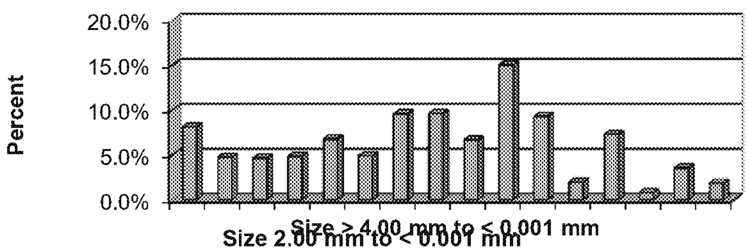
LABORATORY #: 7040309-30/32
IDENTIFICATION: CM9-1
DATE RECEIVED: April 10, 2017

*Gravel and stones are removed first

SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	8.1%	8.1%
1 to 0.75		4.7%	12.9%
0.75-0.50		4.7%	17.5%
0.50-0.35		4.9%	22.4%
0.35-0.25		6.8%	29.2%
0.25-0.18		4.9%	34.1%
0.18-0.125		9.6%	43.7%
0.125-0.088		9.6%	53.4%
0.088-0.062		6.7%	60.1%
0.062-0.031	Silt	15.0%	75.1%
0.031-0.016		9.3%	84.4%
0.016-0.008		2.0%	86.4%
0.008-0.004		7.3%	93.7%
0.004-0.002		0.8%	94.6%
0.002-0.001	Clay	3.6%	98.1%
< 0.001		1.9%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		26.8%	-



Very Coarse Sand %	8.1%		
Coarse Sand %	9.4%		
Medium Sand %	11.7%		
Fine Sand %	24.1%		
Very Fine Sand %	6.7%		
Classification:	**Sandy Loam**		
Sand	60.1%		
Silt	34.5%		
Clay	5.4%		
Effective Size (mm):	10%	=	0.0060
	60%	=	0.1462
Uniformity Coeff. (60%/10%)		=	24.23



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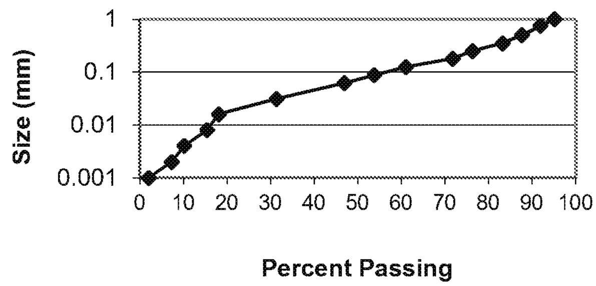
May 5, 2017

Particle Size Distribution

LABORATORY #: 7040309-31/32
IDENTIFICATION: CM10-1
DATE RECEIVED: April 10, 2017



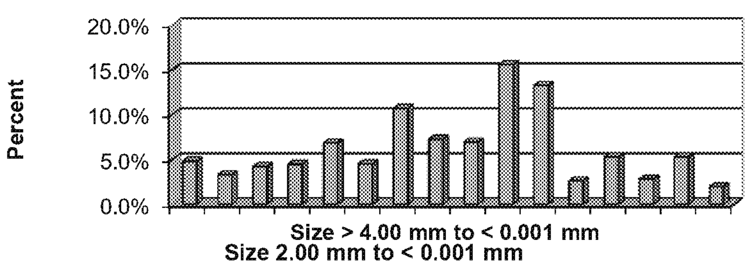
*Gravel and stones are removed first

SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	4.8%	4.8%
1 to 0.75		3.3%	8.1%
0.75-0.50		4.2%	12.4%
0.50-0.35		4.5%	16.8%
0.35-0.25		6.8%	23.7%
0.25-0.18		4.5%	28.2%
0.18-0.125		10.7%	38.9%
0.125-0.088		7.3%	46.2%
0.088-0.062		6.9%	53.1%
0.062-0.031	Silt	15.6%	68.7%
0.031-0.016		13.3%	81.9%
0.016-0.008		2.7%	84.6%
0.008-0.004		5.3%	89.9%
0.004-0.002		2.8%	92.7%
0.002-0.001	Clay	5.3%	98.0%
< 0.001		2.0%	100.0%

*Gravel % based on whole sample (nothing removed)

Gravel		8.3%	-

Very Coarse Sand %	4.8%		
Coarse Sand %	7.5%		
Medium Sand %	11.3%		
Fine Sand %	22.5%		
Very Fine Sand %	6.9%		
Classification:	**Sandy Loam**		
Sand	53.1%		
Silt	39.6%		
Clay	7.3%		
Effective Size (mm):	10%	=	0.0039
	60%	=	0.1195
Uniformity Coeff. (60%/10%)		=	30.45



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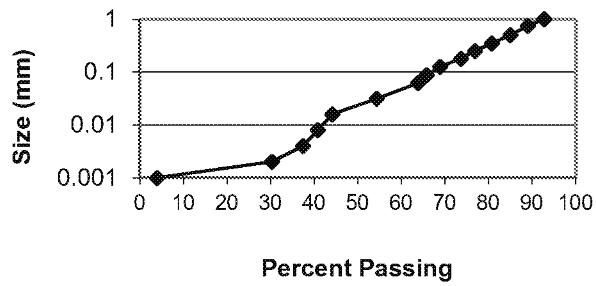
May 5, 2017

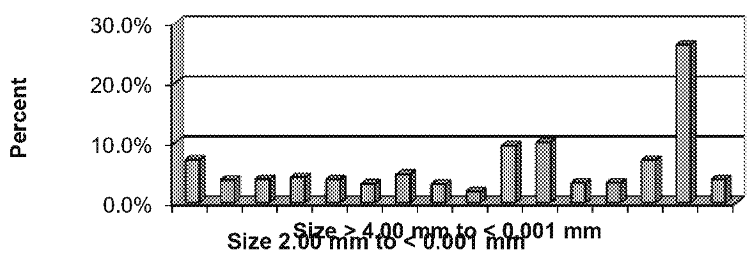
Particle Size Distribution

LABORATORY #: 7040309-32/32
IDENTIFICATION: CM10-2
DATE RECEIVED: April 10, 2017

*Gravel and stones are removed first			
SIZE		FRACTION	CUMULATIVE
2 to 1	Sand	7.2%	7.2%
1 to 0.75		3.8%	11.0%
0.75-0.50		3.9%	15.0%
0.50-0.35		4.3%	19.2%
0.35-0.25		3.9%	23.1%
0.25-0.18		3.2%	26.3%
0.18-0.125		4.8%	31.1%
0.125-0.088		3.1%	34.3%
0.088-0.062		1.9%	36.2%
0.062-0.031	Silt	9.5%	45.7%
0.031-0.016		10.1%	55.8%
0.016-0.008		3.4%	59.2%
0.008-0.004		3.4%	62.6%
0.004-0.002		7.2%	69.7%
0.002-0.001	Clay	26.4%	96.1%
< 0.001		3.9%	100.0%
*Gravel % based on whole sample (nothing removed)			
Gravel		8.7%	-



Very Coarse Sand %		7.2%		
Coarse Sand %		7.8%		
Medium Sand %		8.2%		
Fine Sand %		11.1%		
Very Fine Sand %		1.9%		
Classification:		**Clay Loam**		
	Sand	36.2%		
	Silt	33.6%		
	Clay	30.3%		
Effective Size (mm):		10%	=	0.0012
		60%	=	0.0495
Uniformity Coeff. (60%/10%)			=	40.23



Mike Galloway

APPENDIX I

Minimum Viable Populations for Annual Plants – Life History Parameters

MINIMUM VIABLE POPULATIONS FOR ANNUAL PLANTS

Life History Parameters

Life history parameters from Pavlik (1996) applied to spineflower based on expert opinion (S. Miller and A. Thomson, pers. comm. 2017) are listed below. Traits in boldface are those of species expected to have higher MVPs (2,500 individuals per Pavlik 1996), where the MVP is defined as a 95% probability of survival over 100 years (Mace and Land 1991, as cited in Pavlik 1996). Underlined parameters indicate species with lower MVPs.

Longevity: **annual**

Breeding System: **outcrossing** (but facultative selfer)

Growth Form: **herbaceous**

Fecundity: <u>moderate (Miller) to high (Thomson)</u>

Ramet Production: **rare or none**

Survivorship: **low** (Thomson) to <u>moderate</u> (Miller)

Seed Duration: <u>moderate (Miller) to long (Thomson)</u>

Environmental Variation: <u>moderate</u> (Miller) to **high** (Thomson)

Successional Status: **seral or ruderal**

According to Pavlik (1996), MVPs for species that exhibit traits shown in boldface above (e.g., annual, outcrossing, herbaceous) trend toward population numbers approaching 2,500 individuals. Because spineflower exhibits several of these traits, an MVP of 2,500 individuals is conservative, and would be expected to be somewhat less based on traits such as moderate to long seed duration and moderate to high fecundity.

Other Studies

Although there is limited literature that sets MVPs for annual plants, a few other studies also suggest that annual plant population sizes of less than 2,500 individuals can have relatively low extinction risk. No studies were found with MVPs for annual plants larger than 2,500 individuals. However, most studies reviewed cautioned against setting precise targets for MVPs and stressed that estimates also needed to express the statistical level of uncertainty such as confidence intervals (e.g., Reed et al. 1998). This caution especially applies to species with high demographic and/or environmental variability such as spineflower.

ED_013814_00001552-00329

Matthies et al. (2004) conducted an empirical study of plant population size based on comprehensive dataset for endangered species in Germany over a 10-year period. The dataset included 359 populations of eight short-lived species (range of 36–54 populations of each species) that propagate only by seeds, and which are considered to have transient seed banks or seed banks that are "short-term persistent but depleted quickly." They examined the relationship between population size and survival as well as mean population growth in relation to population size. Overall 73% of the 359 populations survived, ranging from 56% to 84% for the different species. Large populations had a much greater chance of survival than small populations—most populations <6 individuals did not survive, whereas 100% of populations >1,000 individuals did survive. The population size necessary for 90% probability of survival over 10 years varied from 71 individuals for *Lepidium campestre* to 1,276 individuals for *Melampyrum arvense*. Matthies et al. (2004) concluded that extinction risk for populations over 1,000 individuals was "very small."

Bell et al. (2003) conducted a population restoration viability analysis (PRVA) for an annual herb *Cirsium pitcheri,* which is a short-lived monocarpic herb endemic to sand dunes of the western Great Lakes. The species reproduces through seed. It is mostly an outcrosser through insect pollination but can self, resulting in lower seed set (similar to spineflower). *C. pitcheri* exhibits seed dormancy but little seed-banking. Its dune habitat is considered to have high environmental variability. The PRVA assessed the viability of a restoration project by comparing its population size to the MVP size required to achieve an extinction probability <5%. The MVPs for restored populations at two different sites were estimated to be approximately 500 and 200 individuals.

Garcia (2007) conducted a 6-year study of a narrow endemic *Petrocoptis pseudoviscosa*, a rocky outcrop perennial herb species in Spain that reproduces from seed near the mother plant, but with limited dispersal. She studied three populations ranging from 130 to 45,000 individuals with 130, 850, and 1,500 individuals per patch, including spatio-temporal reproductive and survival parameters and growth rates and life history traits in relation to variability in population dynamics, and assessed long-term vulnerability in relation to life history and population size. Garcia found that all three populations had low recruitment rates (10% to 19%). However, stochastic models showed no extinction risk for populations of 130 and 850 individuals over 100 years and 5.7% probability of extinction of the largest patch of 1,500 individuals. Extinction risk differences were due to spatio-temporal variability in reproduction and demographic traits and not population size alone. Although the study indicates that small plant populations can have low extinction risks, Garcia suggests that past adaptive history (or "way of life"; Garcia 2007, p. 7) may be an important component in the extinction risk of small isolated populations; e.g., is habitat loss and fragmentation a recent phenomenon, suggesting higher risk, or has the species adapted to patchy or scarce habitats, suggesting low extinction risk?

Conclusion

Conducting credible population viability analyses (PVAs) for plants is a challenge. In a review of plant PVAs, Menges (2000) found that most PVAs were limited by the short term of the studies (the mean, median, and modal length of studies was less than 5 years) on relatively few populations, suggesting limited information on critical population dynamics information needed for modeling. Menges (2000) indicates that life history challenges to plant PVAs for plants are seed dormancy, periodic recruitment, and clonal growth. For plants with long dormancies, short studies tend to overestimate mortality. In addition, seed bank information is often incomplete. Menges concludes "many authors are hesitant to calculate MVPs, perhaps because of the uncertainty of data and modeling assumptions that go into PVAs, or because of a fear of giving the impression of PVA superiority over more qualitative approaches; that is the 'fallacy of illusory precision'" (Menges 2000, pp. 54–55). One recommendation by Menges (2000) for using PVAs is to assess relative risks of extinction under different management strategies rather than projecting absolute extinction risks.

With the strong caveat that generalizing an MVP from other annual plant species to spineflower must be done with caution, based on a general review of the available literature, setting a success criterion of at least 2,500 individuals for spineflower seems reasonably conservative. The studies reviewed above suggest MVPs for annual plants much smaller than 2,500 individuals and no studies were found indicating large MVPs.

Literature Cited

Bell, T.J., M.L. Bowles, and A.K. McEachern. 2003. "Projecting the Success of Plant Population Restoration with Viability Analysis." *Ecological Studies*, Vol. 165 in *Population Viability in Plants*, edited by C.A. Brigham and M.W. Schwartz.

Garcia, M.B. 2007. "*Life History and Population Size Variability in a Relict Plant: Different Routes towards Long-Term Persistence*." *Diversity and Distributions* 14(1): 106–113. doi: 10.1111/j.1472-4642.2007.00429.x.

Matthies, D., I. Bräuer, W. Maibom, and T. Tscharntke. 2004. "Population Size and the Risk of Local Extinction: Empirical Evidence from Rare Plants." *Oikos* 105:481–488.

Menges, E.S. 2000. "Population Viability Analyses in Plants: Challenges and Opportunities." *Tree* 15(2): 51–56.

Pavlik, B.M. 1996. "A Framework for Defining and Measuring Success during Reintroductions of Endangered Plants." In *Restoring Diversity: Strategies for Reintroduction of Endangered Plants*, edited by D. Falk, C. Millar, and P. Olwell, 127–156. Washington, DC: Island Press.

Reed, J.M., D.D. Murphy, and P.F. Brussard. 1998. "Efficacy of Population Viability Analysis." *Wildlife Society Bulletin* 26:244–251.

APPENDIX J

Implementation and Long-Term Management Costs

Newhall Spineflower Introduction Program
Implementation Cost Estimate

August 14, 2017

Preliminary Cost Estimate - Test Plots, Site Prep., Soil Salvage, Seeding, 10-Yr. Maintenance and Monitoring						
Costs are non-prevailing wage installation costs. Estimate based upon the following assumptions:						
	Weed control in 50-foot buffer areas (10 ac)					
	Total Introduction Area: (10 acs.)					
	Total Conservation Area: (~1,500 ac)					
Note: Estimate is based upon Spineflower Introduction Plan (August 2017)						
No.	**Task /Item Description**	**Quantity**	**Unit**	**Unit Price**	**Subtotal**	**Total**
A	**TEST PLOTS (Assume 5 blocks per area for 25 total, plus 1 at EL for 26)**					
1	Weed Control (thatch removal, grow-kill cycles)					
2	Soil Preparation and plot establishment (excavation, compaction, etc.)					
3	Watering, Seeding, etc.					
4	Topsoil Placement					
5	2-year Maintenance (3 phases); Eliz Lake Reduced to 1 test plot					
6	2-year Monitoring and Reporting (6X/year plus report) (3 phases with 2 areas					
	Subtotal:					
B	**SITE PREPARATION - INTRO AREAS**					
1	Weed Control					
2	Soil Preparation (Scraping, compaction, etc.)					
3	Watering					
4	Topsoil Salvage/Placement					
	Subtotal:					
C	**SUPPLEMENTAL HAND WATERING:**					
1	Water Truck Watering 12 Times (8 days to cover all sites)					
	Subtotal:					
D	**SEED APPLICATION AND DOCUMENTATION**					
1	Seed bulking (RSABG) and wild collections					
2	Seeding (application, tamping, etc.)					
3	Documentation and mapping					
	Sub-total:					
E	**MAINTENANCE OF INTRO AREAS AND 50-FOOT BUFFER AREAS**					
1	Seeding buffer areas (rake and cover); assume 50% of area					
2	Seeding intro areas (hand broadcast); assume 50% of area					
3	10-Year maintenance program (3 phases)					
	Sub-total:					
F	**MONITORING**					
1	Biological Monitoring (Ref sites at Laskey, Newhall and Intro Sites)					
2	Reporting and Documentation					
	Sub-total:					
G	**INITIAL AND CAPITAL COSTS FOR CONSERVATION AREAS**					
1	Install signage					
2	Install fencing - conservation areas					
3	Patrolling, trash removal, fencing inspections, general reconaissance (monthl					
4	Establish conservation easements					
5	Agency coordination, meetings, and reporting on easement compliance					
	Sub-total:					
	PROJECT IMPLEMENTATION TOTAL:					

Cost Estimate Summary		
A	Test Plots	
B	Site Prep	
C	Supplemental Watering	
D	Seed Application	
E	Maintenance	
F	10 Yr. Monitoring	
G	Initial and Capital Costs for Conservatiion Areas	
	PROJECT TOTAL	
	10% Contingency	
	PROJECT TOTAL	

Ex. 4 CBI

San Fernando Valley Spineflower Enhancement and Introduction Plan
Newhall Land
08.14.2017
Long-Term Management Costs for the Spineflower Introduction Plan

Ongoing Management Phase (Year 11+)	SCP Ref	Unit	Quantity	Unit Cost	Times Years	Annual Cost	Staff	Assumptions
Phase 1: San Martinez Grande Preserve Expansion - LA County and Potrero Preserve Expansion								
Biotic Surveys								
Spineflower annual monitoring and general condition of the conservation area	SCP 11.2, 11.4	hr						
Spineflower qrtrly qualitative monitoring	SCP 11.5	hr						
Spineflower aerial extent mapping	SCP 11.2	hr						
Spineflower abundance/density sampling	SCP 11.2	hr						
Spineflower introduction area vegetation monitoring	SCP 11.3	hr						
Habitat Maintenance								
Spineflower preserve exotic plant control	SCP 11.3	hr						
Spineflower preserve exotic plant mgt	SCP 11.4	hr						
Spineflower preserve exotic plant monitoring	SCP 11.5	hr						
Argentine ant monitoring/control	SCP 11.5.2	hr						
Public Services								
Patrolling / Enforcement	SCP11.5.1	hr						
General Maintenance								
Signage repair,trash removal; qrtrly	SCP 11.6	hr						
Annual fence maintenance	SCP 9.2.5	lf						
Fence replacement	SCP 9.2.5	lf						
Reporting								
Spineflower preserve imagery	SCP 11.3	item						
Spineflower Management Plan / SCP update	SCP App D	hrs						
Adaptive management working group	SCP	hrs						
Data management and Information Center	SCP 10.5.5	hrs						
Spineflower preserve qrtrly/annual reporting	SCP 11.5, 15	hrs						
Office Maintenance								
Office space, equipment, supplies allowance	n/a	item						
Field Equipment								
Field equipment allowance	n/a	item						
Operations								
Audit								
Insurance								
Spineflower emer response and adaptive mgt allowance	SCP Section 10	item						

Ex. 4 CBI

San Fernando Valley Spineflower Enhancement and Introduction Plan
Newhall Land
08.14.2017
Long-Term Management Costs for the Spineflower Introduction Plan

Ongoing Management Phase (Year 11+)	SCP Ref	Unit	Quantity	Unit Cost	Times Years	Annual Cost	Staff	Assumptions
Phase 2: San Martinez Grande Preserve Expansion - Ventura County and Castaic Mesa								
Biotic Surveys								
Spineflower annual monitoring and general condition of the conservation area	SCP 11.2, 11.4	hr						
Spineflower qrtrly qualitative monitoring	SCP 11.5	hr						
Spineflower aerial extent mapping	SCP 11.2	hr						
Spineflower abundance/density sampling	SCP 11.2	hr						
Spineflower introduction area vegetation monitoring	SCP 11.3	hr						
Habitat Maintenance								
Spineflower preserve exotic plant control	SCP 11.3	hr						
Spineflower preserve exotic plant mgt	SCP 11.4	hr						
Spineflower preserve exotic plant monitoring	SCP 11.5	hr						
Argentine ant monitoring/control	SCP 11.5.2	hr						
Public Services								
Patrolling / Enforcement	SCP11.5.1	hr						
General Maintenance								
Signage repair,trash removal; qrtrly	SCP 11.6	hr						
Annual fence maintenance	SCP 9.2.5	lf						
Fence replacement	SCP 9.2.5	lf						
Reporting								
Spineflower preserve imagery	SCP 11.3	item						
Spineflower Management Plan / SCP update	SCP App D	hrs						
Adaptive management working group	SCP	hrs						
Data management and Information Center	SCP 10.5.5	hrs						
Spineflower preserve qrtrly/annual reporting	SCP 11.5, 15	hrs						
Office Maintenance								
Office space, equipment, supplies allowance	n/a	item						
Field Equipment								
Field equipment allowance	n/a	item						
Operations								
Audit	n/a	item						
Insurance	n/a	acre						
Spineflower emer response and adaptive mgt allowance	SCP Section 10	item						

Ex. 4 CBI

Ongoing Management Phase (Year 11+)	SCP Ref	Unit	Quantity	Unit Cost	Times Years	Annual Cost	Staff	Assumptions
Phase 3a - Ventura County - Facing Simi Valley								
Biotic Surveys								
Spineflower annual monitoring and general condition of the conservation area	SCP 11.2, 11.4	hr						
Spineflower qrtrly qualitative monitoring	SCP 11.5	hr						
Spineflower aerial extent mapping	SCP 11.2	hr						
Spineflower abundance/density sampling	SCP 11.2	hr						
Spineflower introduction area vegetation monitoring	SCP 11.3	hr						
Habitat Maintenance								
Spineflower preserve exotic plant control	SCP 11.3	hr						
Spineflower preserve exotic plant mgt	SCP 11.4	hr						
Spineflower preserve exotic plant monitoring	SCP 11.5	hr						
Argentine ant monitoring/control	SCP 11.5.2	hr						
Public Services								
Patrolling / Enforcement	SCP11.5.1	hr						
General Maintenance								
Signage repair,trash removal; annually	SCP 11.6	hr						
Annual fence maintenance	SCP 9.2.5	lf						
Fence replacement	SCP 9.2.5	lf						
Reporting								
Spineflower preserve imagery	SCP 11.3	item						
Spineflower Management Plan / SCP update	SCP App D	hrs						
Adaptive management working group	SCP	hrs						
Data management and Information Center	SCP 10.5.5	hrs						
Spineflower preserve qrtrly/annual reporting	SCP 11.5, 15	hrs						
Office Maintenance								
Office space, equipment, supplies allowance	n/a	item						
Field Equipment								
Field equipment allowance	n/a	item						
Operations								
Audit	n/a	item						
Insurance	n/a	acre						
Spineflower emer response and adaptive mgt allowance	SCP Section 10	item						

Ex. 4 CBI

Ongoing Management Phase (Year 11+)	SCP Ref	Unit	Quantity	Unit Cost	Times Years	Annual Cost	Staff	Assumptions
Phase 3b - Elizabeth Lake - Detailed Costs To Be Determined								
Biotic Surveys								
Spineflower annual monitoring and general condition of the conservation area	SCP 11.2, 11.4	hr	Ex. 4 CBI					
Spineflower qrtrly qualitative monitoring	SCP 11.5	hr						
Spineflower aerial extent mapping	SCP 11.2	hr						
Spineflower abundance/density sampling	SCP 11.2	hr						
Spineflower introduction area vegetation monitoring	SCP 11.3	hr						
Habitat Maintenance								
Spineflower preserve exotic plant control	SCP 11.3	hr						
Spineflower preserve exotic plant mgt	SCP 11.4	hr						
Spineflower preserve exotic plant monitoring	SCP 11.5	hr						
Argentine ant monitoring/control	SCP 11.5.2	hr						
Public Services								
Patrolling / Enforcement	SCP11.5.1	hr						
General Maintenance								
Signage repair,trash removal; annually	SCP 11.6	hr						
Annual fence maintenance	SCP 9.2.5	lf						
Fence replacement	SCP 9.2.5	lf						
Reporting								
Spineflower preserve imagery	SCP 11.3	item						
Spineflower Management Plan / SCP update	SCP App D	hrs						
Adaptive management working group	SCP	hrs						
Data management and Information Center	SCP 10.5.5	hrs						
Spineflower preserve qrtrly/annual reporting	SCP 11.5, 15	hrs						
Office Maintenance								
Office space, equipment, supplies allowance	n/a	item						
Field Equipment								
Field equipment allowance	n/a	item						
Operations								
Audit	n/a	item						
Insurance	n/a	acre						
Spineflower emer response and adaptive mgt allowance	SCP Section 10	item						
Ongoing Management Phase (Year 11+) Subtotal						Ex. 4 CBI		
Administrative Costs (24% of Subtotal)								
Ongoing Management Phase (Year 11+) Total								
Spineflower Introduction Areas In Perpetuity Endowment (4.0% cap rate)								

> *Assumption: Biotic Surveys, habitat maintenance, and general maintenance during the Initial Management Phase (Years 1-10) would be covered by the Implementation Costs (estimated separately*
> *Assumption: 10% contingency applied to all line items*
> *Assumption: Spineflower introduction areas will be managed consistent with the long-term management of the other Spineflower Preserves, as specified in the Spineflower Conservation Plan (SCP)*

San Fernando Valley Spineflower Enhancement and Introduction Plan
Five Point
5.3.2017
ROLLED UP Long-Term Management Costs for the Spineflower Enhancement and Introduction Plan

Ongoing Management Phase (Year 11+)	Annual Cost
ON-SITE, ADJACENT, AND OFF-SITE INTRODUCTION CONSERVATION AREAS (All 6 Spineflower Introduction Conservation Areas)	
Biotic Surveys	
Spineflower annual monitoring and general condition of the conservation area	
Spineflower qrtrly qualitative monitoring	
Spineflower aerial extent mapping	
Spineflower abundance/density sampling	
Spineflower introduction area vegetation monitoring	
Habitat Maintenance	
Spineflower preserve exotic plant control	
Spineflower preserve exotic plant mgt	
Spineflower preserve exotic plant monitoring	
Argentine ant monitoring/control	
Public Services	
Patrolling / Enforcement	
General Maintenance	
Signage repair,trash removal; qrtrly	
Annual fence maintenance	
Fence replacement	
Reporting	**Ex. 4 CBI**
Spineflower preserve imagery	
Spineflower Management Plan / SCP update	
Adaptive management working group	
Data management and Information Center	
Spineflower preserve qrtrly/annual reporting	
Office Maintenance	
Office space, equipment, supplies allowance	
Field Equipment	
Field equipment allowance	
Operations	
Audit	
Insurance	
Spineflower emergency response and adaptive mgt allowance	
Ongoing Management Phase (Year 11+) Subtotal	
Administrative Costs (24% of Subtotal)	
Ongoing Management Phase (Year 11+) Total	
Spineflower Introduction Areas In Perpetuity Endowment (4.0% cap rate)	

- *Assumption: Biotic Surveys, habitat maintenance, and general maintenance during the Initial Management Phase (Years 1-10) would be covered by the Implementation Costs (estimated separately)*
- *Assumption: 10% contingency applied to all line items*
- *Assumption: 10 years of Initial costs funded by Newhall Land; Ongoing costs in Years 11+ funded by endowment*
- *Assumption: Spineflower introduction areas will be managed consistent with the long-term management of the other Spineflower Preserves, as specified in the Spineflower Conservation Plan (SCP).*

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